ARSENAL STREET
CORRIDOR STUDY

PREPARED FOR

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Massachusetts Department of Transportation

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Executive Summary

The Arsenal Street Corridor Transportation Study (the study) is a partnership between the Massachusetts Department of Transportation (MassDOT), Massachusetts Bay Transportation Authority (MBTA), the Town of Watertown, and surrounding municipalities. The consultant team is led by VHB with support from Regina Villa Associates (RVA) and RKG Associates, Inc. (RKG). The study evaluates the existing and future multimodal transportation conditions along the Arsenal Street corridor in Watertown and the effects of/to adjacent municipalities. The study develops and analyzes alternatives that are intended to improve transportation conditions, with a primary focus on the bus service along Arsenal Street and locations where the bus service interfaces with other crossing routes. Alternatives are evaluated in the context of the overall traffic network, for their impact on vehicular, bicycle and pedestrian use, bus service, land use, and cost.

The study examined and analyzed mobility under existing conditions and under year 2040 conditions. Immediate-term, short-term, medium-term, and long-term recommendations have been developed using both quantitative information from analyses and qualitative feedback provided by the study's Working Group and the public. In some cases, Watertown has been proactive in starting to address identified issues and carry out immediate-term recommendations. The study includes an "Action Plan" for implementation of the short-, medium-, and long-term study recommendations.

This report is organized into six chapters that generally correspond to the major work tasks. Highlights from each chapter are discussed below.

ES.1 Chapter 1: Study Process and Framework

Chapter 1 outlines the study process and background, study area, goals and objectives, and the evaluation criteria developed to test the feasibility of alternatives. The chapter also highlights the public participation plan established for the project and each outreach meeting held throughout the course of the study.

ES.2 Chapter 2: Existing Conditions

Chapter 2 describes the existing (2016) conditions in the study area, including discussions of demographics, environmental resources, land use and economic development, public health, a multimodal transportation assessment, a safety evaluation, and a summary of the transportation infrastructure deficiencies within the study area.

ES.3 Chapter 3: Future Conditions, Issues and Opportunities

Chapter 3 assesses the 2040 Future Conditions, including land use forecasts, planned infrastructure improvements, future traffic demand forecasts, and future traffic operations within the study area. Issues, opportunities, and constraints that evolved from a thorough review of data and the compilation of concerns and desired outcomes (identified through the public outreach process) are also discussed. The analysis of existing and future transportation conditions and development of issues, opportunities and constraints in the study area identified areas of the transportation network that require improvements and guided the development of study alternatives.

ES.4 Chapter 4: Alternatives Development and Screening

Chapter 4 outlines the alternatives developed for study through the public outreach process. A range of 18 transportation improvements were identified through Working Group guidance and public outreach. These alternatives were organized into four categories:

- Bicycle Improvements
- Multi-modal Improvements
- Transit Options
- Vehicle Options

For each of the 18 alternatives, a “fatal flaw” analysis was completed to determine which components could be feasible solutions to congestion issues and multimodal deficiencies in the study area. The project goals were used as an abbreviated list of criteria against which to measure the alternatives. Any alternative showing merit was retained for consideration and subject to a more detailed technical analysis to determine the transportation benefit versus the associated impacts to the environment, economic development in the area, and other factors. The chapter also identifies which alternatives were considered, but dismissed, prior to detailed analysis. Table ES-1 summarizes the results of the alternatives screening process.

In addition to the alternatives screened above, three categories of improvements were identified for immediate implementation by the Town: road safety audits (RSAs), traffic signal deficiencies/ compliance, and curb ramp improvements. While implementation is still ongoing, it is noted that an RSA for the intersection of Galen Street at Watertown Street/Nonantum Road was recently completed by MassDOT. Where appropriate, findings from the RSA are incorporated into the alternatives development at Watertown Square.

Table ES-1 Alternatives Screening Summary

Retained for Further Evaluation	Discarded from Consideration	Comments
Alternative 1: Bike Lanes East of School Street		Analysis will identify property impacts and develop typical cross-sections and consider planned athenahealth improvements.
	Alternative 2: Off-Road, Parallel Connections to Charles River	Discarded due to constructability concerns and in favor of Alternative 3. Alternative 2 could be pursued separately by the Town and/or DCR.
Alternative 3: Cross Connectivity between the Greenway and Charles River		Analysis will identify potential cross-connections and impacted property owners and develop typical cross-sections.
	Alternative 4: Separated Bike Lane East of School Street	Discarded due to impacts to private property. There may be an opportunity to incorporate separated bike lanes along Arsenal Street where right-of-way allows into Alternative 1.
Alternative 5: Road Diet East of School Street		Analysis will include a roadway capacity threshold evaluation and identification of potentially impacted parallel routes.
Alternative 6: Soldiers Field Road Gateway Improvement		Analysis will evaluate signal timing/phasing modifications, intersection geometry changes, incorporation of pedestrian accommodations, restriping, and/or Coolidge Avenue relocation.
Alternative 7: Watertown Square Gateway Improvement		Analysis will evaluate signal timing/phasing modifications, improved coordination, lane use changes, pedestrian accommodation enhancements, and/or Charles River Road relocation.
	Alternative 8: Traffic Signal Optimization	Discard as retiming is being progressed as part of on-going development projects within the study area.
	Alternative 9: Wayfinding	Discarded as a stand-alone improvement. Consider incorporating into preferred bicycle alternative and/or Alternatives 6 and 7.
Alternative 10: Express Bus along North Beacon Street		Analysis will evaluate whether the service could draw sufficient ridership to warrant full study.
Alternative 11: Transit Signal Priority (TSP)		Analysis will include queue bypass lanes, traffic signal timing/phasing options, and bus stop relocation/consolidation.
	Alternative 12: Watertown Square Bus Alternative	Discarded as a stand-alone improvement. Consider incorporating into Alternative 7.
Alternative 13: Transit Stop Turnouts/Curb Extensions		Analysis will consider spatial constraints (ADA guidelines) and qualitatively assess benefits to on-time performance and travel time improvements for bus bays versus curb extensions.
Alternative 14: Transit Shelters		Analysis will consider spatial requirements for installation of a shelter and identify existing constraints to the extent feasible.
Alternative 15: Existing Transit Service Improvements		Analysis will consider impacts on on-time performance, passenger crowding, and travel times of each sub-alternative.
	Alternative 16: Consolidated Shuttle Service	Discarded due to limited operational services at this time. Could be pursued by others when there are services from multiple employers operational.
Alternative 17: Adaptive Signal Control (ASC)		Analysis of this alterative will consider various ACS technologies and evaluate their appropriateness for the Arsenal Street corridor.
	Alternative 18: Overhead Lane Indication Signage	Discarded as a stand-alone improvement. Consider incorporating into Alternative 7.

ES.5 Chapter 5: Alternatives Analysis

Chapter 5 presents a detailed evaluation of each alternative carried forward for technical analysis. Of the 11 alternatives analyzed, nine are advanced as study recommendations (as discussed in Section ES.6). The two alternatives dismissed include:

Alternative 5: Road Diet East of School Street: Alternative 5 evaluated a road diet for the four-lane section of Arsenal Street from east of School Street to Greenough Boulevard to improve multimodal conditions. Two potential road diet options were considered, both within the existing curb-to-curb width. For either road diet option to be successful, significant traffic diversions would be necessary during the peak hours which may not be feasible given the significant land use nodes, both existing and planned, along the corridor. Further, there are limited parallel routes to accommodate diverted traffic from Arsenal Street and impacts to neighborhoods both to the north and south are anticipated. The study recommends eliminating Alternative 5 from consideration due to severe impacts to Arsenal Street mobility and anticipated parallel route diversions.

Alternative 13: Transit Stop Turnouts/Curb Extensions: This alternative considered the spatial requirements for bus turnouts and curb extensions. Bus turnouts require buses to exit the travel lane and can have negative impacts to transit operations and reliability due to the delays of buses in entering traffic from the turnout. While curb extensions are preferable for transit operations, they would impact general traffic flow, on-street parking, and potentially bicycle accommodations. Given the limited available width along the corridor and the potential to further disrupt transit operations, both options were discarded from consideration.

ES.6 Chapter 6: Recommendations

Chapter 6 summarizes the benefits of each recommended alternative and presents an "Action Plan" for the study recommendations. The study recommendations include:

Alternative 1: Bike Lanes East of School Street: This alternative considers options to extend bicycle accommodations in each direction of Arsenal Street east of School Street to the Charles River. Narrowing the travel lanes to 11-feet would not create enough space for the provision of five-foot bike lanes within the existing right-of-way (ROW). Two options to provide narrower accommodations were developed and analyzed. It is recommended that the Town continue to advance this alternative and, where practical, strive to achieve a five-foot width. Benefits of this alternative include the potential to reduce auto dependency, improve connectivity, and support active transportation initiatives.

Alternative 3: Cross Connectivity between the Greenway and Charles River: This alternative considers cross connections between the Watertown Greenway/Arsenal Street and the Charles River. Several connections are being advanced by either the Town of Watertown or private developers. Additional north-south connections along Irving Street, Beechwood Avenue, and Louise Street/Paul Street were considered to further improve access between the residential neighborhoods both north and south of Arsenal Street and the Charles River. It is recommended that the Town consider community outreach to develop specific recommendations, including potential shared lane markings and potentially formalizing Charles River Road crossings. Similar to Alternative 1, benefits of this alternative include the potential to reduce auto dependency, improve connectivity, and support active transportation initiatives.

Alternative 6: Soldiers Field Road Gateway Improvement: Alternative 6 evolved to focus on the Arsenal Street at Coolidge Avenue/Arlington Avenue intersection due to ongoing City of Boston involvement with current development projects along Western Avenue. Two improvement options were developed to relocate Coolidge Avenue; the alternative also includes signal timing and phasing modifications. Both relocation options are anticipated to require extensive environmental permitting. The study recommends advancing Alternative 6 by initiating outreach to affected Coolidge Avenue stakeholders and determining whether a preferred alternative can be progressed from the conceptual designs. Benefits of this alternative include improved traffic flow, intersection safety, operations, and systems reliability; increased access for all users; and modifications to noted safety deficiencies.

Alternative 7: Watertown Square Gateway Improvement: This alternative includes signal timing/phasing and coordination modifications, lane use changes, pedestrian accommodation enhancements, the potential relocation of Charles River Road, relocation of the Routes 70/70A eastbound bus stop, and enhanced wayfinding. The study recommends advancing Alternative 7 by initiating public outreach and progressing the concept plan through design development. Benefits of this alternative include enhanced safety, improving approach/movement alignments, and modifying north/south phasing; reduced queues; improved pedestrian and bicycle accommodations, and the creation of additional open space. Eliminating the Charles River Road approach to the intersection may also reduce "cut-through" traffic in the adjacent neighborhood. However, it was noted through the public outreach process that Alternative 7 would include further refinement, traffic analysis, and more detailed evaluation of the potential benefits and impacts on adjacent neighborhoods, specifically along North Beacon Street, Irving Street, Riverside Street, and Charles River Road. The compatibility of modified traffic patterns as part of this alternative would be considered in conjunction with incorporating potential Complete Streets elements as identified in Alternative 3.

Alternative 10: Express Bus along North Beacon Street: Alternative 10 considers supplementing the existing MBTA Route 70/70A service with express bus service along North Beacon Street to improve connections between Watertown and Boston. Preliminary ridership estimates generally support this type of service for the peak periods. Based on potential travel times, service headways, and MBTA resource constraints, it is recommended that a pilot commuter shuttle program be advanced between Watertown Square and the Boston Landing commuter rail station in Brighton. The primary benefits of this alternative include the potential to reduce crowding on Routes 70/70A and/or other bus routes serving Watertown Square and increased transportation options and connections, particularly to rapid growth areas of South Boston.

Alternative 11: Transit Signal Priority (TSP): The study recommends implementing TSP at eight signalized intersections to the east of Watertown Square. To maximize system effectiveness, relocation or consolidation of four bus stops is also recommended. Benefits of this alternative include improved system reliability, primarily for transit services; a potential decrease in auto dependency; and minimized greenhouse gas emissions.

Alternative 14: Transit Shelters: This alternative considered transit shelters at eight bus stops that meet MBTA eligibility criteria. Based on a review of spatial requirements and existing constraints, transit shelters are recommended at four locations where only minor to moderate property impacts are anticipated, primarily to grass buffers. The primary benefit of this alternative is that it supports healthy design principles. If combined with other transit improvements, shelters may help to reduce auto dependency.

Alternative 15: Existing Transit Service Improvements: This alternative involves both short- and medium-term actions. In the short term, the MBTA may consider service frequency and scheduling improvements that can be implemented with existing resources, aimed at reducing Route 70/70A overcrowding and providing more evenly timed service along the Arsenal Street Corridor. In the medium term and beyond, expanding the bus fleet could support additional adjustments to routing and increased service frequency. It is recommended that consideration be given to splitting the existing Routes 70 and 70A into three routes - the existing Route 70, the overlapping “Trunk Route” portion of Routes 70 and 70A, and the North Waltham “Loop Circulator” portion of Route 70A. Consideration should be given to improving service and/or expanding the service span on the “Loop Circulator,” as the split routes would create one of the largest bus-to-bus transfer points in the MBTA system at Waltham Center. Further consideration may be given to adding limited-stop express service on the “Trunk Route” or providing consolidated stop service for all trips. This package of medium-term improvements would further benefit from schedule and service frequency adjustments to accommodate future ridership demand, which may include trip shifts and additional trips during the off-peak and peak periods. Benefits of these recommendations include improved reliability and on-time performance, ability to target service increases to alleviate crowding, more evenly distributed service headways, potential for reduced travel times, increased capacity to accommodate projected demand, and potential to induce new transit demand.

Alternative 17: Adaptive Signal Control (ASC): Alternative 17 involves implementing ASC technologies at ten locations east of Watertown Square to optimize traffic flow and progression. Benefits of this alternative include improved traffic flow, operations, and system reliability; the potential to minimize greenhouse gas emissions; enhanced existing transit services; and the potential for real-time monitoring of traffic volumes and operations.
Table ES-2 presents the details of the Action Plan for the recommended improvements, including construction cost estimates, potential funding sources, the responsible facilitating organizations, the implementation timeframe, and specific next steps.

Table ES-2 Recommended Action Plan – Commitment Matrix and Implementation Timeframe

			Facilitating Organizations					Implementation Timeframe (Years)											Next Steps		
								Short-Term					Medium-Term					Long-Term			
Alternative	Construction Cost [1]	Possible Funding Source(s)	MassDOT	MBTA	DCR	Town of Watertown	EEA	1	2	3	4	5	6	7	8	9	10	10+	Next Steps	Responsible Party	Notes
1. Bicycle Lanes east of School Street	$75,000 to $2,100,000[2]	• State Complete Streets • State Chapter 90 • Private developer			X	X		■	■	■									Advance to final design. Seek funding source(s).	Town	No environmental review/perming anticipated. Preferable to coordinate with athenahealth bike lanes.
3. Cross Connectivity between the Greenway and Charles River	Variable	• Paths being advanced by others • Town funds for shared lane markings			X	X		■	■	■	■	■							Support path development by others. Determine support for Complete Streets elements on neighborhood streets.	Town	No environmental review/perming anticipated. May be required if formal crossings of Charles River Road are developed
6. Soldier's Field Road Gateway Improvements	$1,500,000 to $2,500,000	• Town funds • Private developer • State Transportation Improvement Program	X		X	X	X						Permitting and Design	■	■	■	■	Construction	Advance design. Stakeholder outreach. Research permitting requirements.	Town	ROW acquisition anticipated. Will require additional public and stakeholder outreach.
7. Watertown Square Gateway Improvements	$950,000 to $1,500,000[3]	• Town funds • Private developer • State Transportation Improvement Program	X	X	X	X	X			Permitting and Design	■	■	Construction	■	■				Advance design. Engage DCR. Study Charles River Road cut-through traffic impacts.	Town	ROW acquisition anticipated. Will require additional public and stakeholder outreach.
10. North Beacon Street Express Bus	Variable	• Area stakeholders • MBTA • TMA		X		X							Pilot Program	■	■	■	■	Full Service	Establish pilot program.	Town/MBTA	Potential ROW acquisition for transit stops.
11. Transit Signal Priority	$250,000 + Upgrades[4]	• Town funds • Private Developer		X		X			■	■	■	■							Advance system design. Coordinate bus stop modifications. Identify signal upgrades.	Town/MBTA	ROW acquisition or easements anticipated for relocation of bus stops.
14. Transit Shelters	$30,000/ location	• Town funds • Private Developer • MBTA		X		X		■	■										Determine installation & maintenance responsibility. Initiate easement process.	Town/MBTA	All locations require small easements from property owners (ROW acquisition).
15. Transit Service Improvements to Existing Routes	$3,600,000[5]	• MBTA		X		X		With Existing Fleet	■	■	■	■	With Expanded Fleet	■	■	■	■		Further analyze and refine as part of the MBTA's bus service planning process and bus improvement plan initiative.	MBTA	Alternative 15 cost estimates are intended solely for purposes of comparing alternatives within the context of this study and are not for budgeting purposes. Capital and operating costs will depend on the allocation of MBTA resources across all system routes based on systemwide priorities.
17. Adaptive Signal Control	$250,000 to $500,000[4,6]	• Town funds • Private Developer		X		X				Planning/ Implementation	■	■	Refinement/Upgrades	■	■	■	■	Maintenance	Advance system design. Identify signal upgrades. Further evaluate Watertown Square operations.	Town	

MassDOT - Massachusetts Department of Transportation, MBTA - Massachusetts Bay Transportation Authority, DCR - Department of Conservation and Recreation, EEA - Executive Office of Energy and Environmental Affairs

Information on state funding sources can be found at the following locations: Complete Streets (mass.gov/massdot/completestreets), Chapter 90 (mass.gov/massdot/chapter90), State Transportation Improvement Program (ctps.org/tip-dev)

[1] Construction cost estimates in 2017 dollars. Estimates do not include survey, design fees, right-of-way (ROW) acquisition, permitting, drainage improvements, or utility modifications (if necessary).

[2] Lower cost estimate includes removal of paint markings and restriping only. Higher cost estimate includes cold plane/overlay in addition to restriping.

[3] Costs may be increased by signal system upgrades/modifications, hardscape/ landscape design, pedestrian lighting, site furnishings.

[4] New traffic signal cabinet assembly may be required at some locations. The cost of a new assembly is approximately $40,000 per location. If the intersection is recommended for both transit signal priority and adaptive signal control, this cost is incurred only once.

[5] Estimate includes capital cost only for additional vehicles anticipated for medium-term recommendations, and excludes capital costs associated with expanded fleet storage and maintenance facilities. Incremental operating costs are estimated at $200,000 and $800,000 per year for short-term and medium-term recommendations, respectively.

[6] Ultimate cost will be dependent on type of communication and server chosen.

1

Study Process and Framework

This chapter describes the process and framework for this study – outlining the goals and objectives along with the mechanics of how these goals and objectives were achieved through the study process. Arguably the most crucial element of the study process was the public outreach plan. The public outreach plan is the Study Team's approach to sharing information and ideas with the general public and an established Working Group throughout the study to ensure an open, transparent, and collaborative process.

The goal of the study is to improve multimodal transportation conditions with a primary focus on the bus service along Arsenal Street and locations where the bus service ties into other crossing bus routes, as well as other connections to the regional transit system.

Introduction

The Arsenal Street Corridor Transportation Study (the study) is a partnership between the Massachusetts Department of Transportation (MassDOT), Massachusetts Bay Transportation Authority (MBTA), the Town of Watertown, and surrounding municipalities. The consultant team is led by VHB with support from Regina Villa Associates (RVA) and RKG Associates, Inc. (RKG). This is a comprehensive state-sponsored study evaluating the existing and future multimodal transportation conditions along the Arsenal Street corridor in Watertown and its surrounding municipalities. The study develops and analyzes alternatives that are intended to improve transportation conditions, with a primary focus on the bus service along Arsenal Street and locations where the bus service interfaces with other crossing routes. Alternatives are evaluated for their impact on bus service, vehicular, bicycle and pedestrian use, land use, and cost, as well as in the context of impact on current users of the transportation network.

This study examined and analyzed mobility under existing conditions and under year 2040 conditions. Immediate-term, short-term, medium-term, and long-term recommendations have been developed using both quantitative information from analyses and also qualitative feedback provided by the Working Group established as part of this study (see more information below) and the public.

Public outreach has been an integral component of the study. The study has been guided by a Working Group comprised of local municipal representatives, state agency representatives, elected officials, members of the Watertown Public Transit Task Force (which was established in an effort to promote more efficient public transit through Watertown and surrounding towns), local advocacy groups, and individuals representing business, the environment, traditionally underserved populations, and transportation interests. The members of the Working Group and all meeting notes are included in the Appendix.

Over the course of the project, Working Group members met six times to discuss the methodology, data, analysis, and findings of the project. Comments from the Working Group were incorporated into the presentations at each of three public meetings.

This report documents all phases of the work effort for this study and is organized as follows:

- Chapter 1 – Study Process and Framework
- Chapter 2 – Existing Conditions
- Chapter 3 – Future Conditions, Issues and Opportunities
- Chapter 4 – Alternatives Development
- Chapter 5 – Alternatives Analysis
- Chapter 6 – Recommendations

Study Process and Background

A comprehensive corridor study involves a well-defined structure and process. The planning effort is organized into six tasks:

- Task 1: Framework – Develop the framework for the study, including study area, goals and objectives, evaluation criteria, and the public involvement plan.
- Task 2: Existing and Future Conditions and Issues Evaluation – Evaluate existing and anticipated future (2040) conditions for the study area, including transit services, traffic congestion, pedestrians, bicyclists, safety, environmental

issues, community effects, economic development, land use, public health. Identify existing issues, opportunities and constraints.

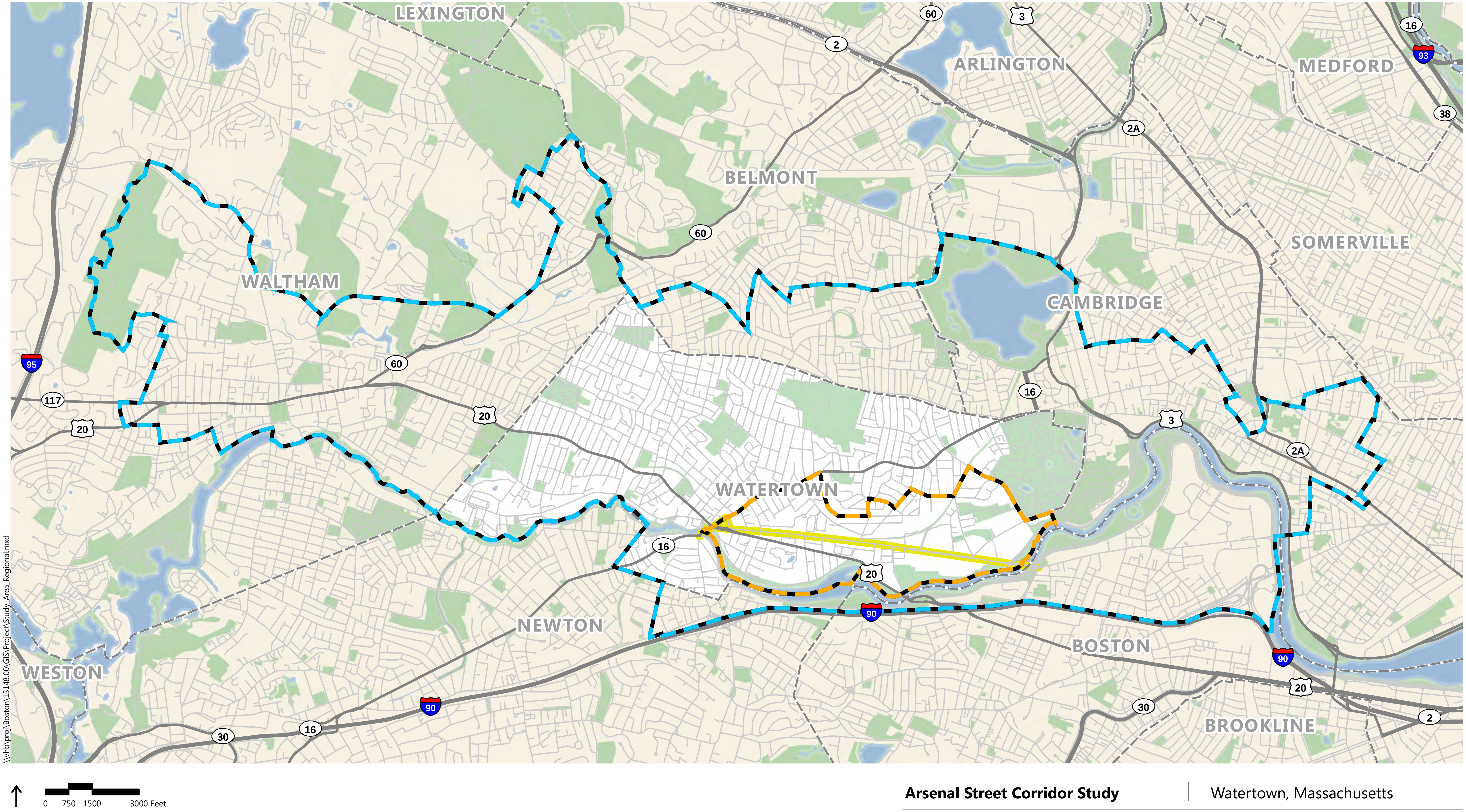
- Task 3: Alternatives Development – Develop and refine a range of potential alternatives based on the transportation deficiencies, issues, and constraints, particularly as they relate to bus service along Arsenal Street and locations where the bus service ties into other crossing bus routes. Identify immediate or near-term improvements that could be implemented with existing resources or at minimal cost.
- Task 4: Alternatives Analysis – Analyze potential alternatives based on the established evaluation criteria relative to multimodal mobility, safety, the environment, land use and economic development, the community, constructability, cost, and public health.
- Task 5: Recommendations – Develop a coordinated set of short-, medium-, and long-term recommendations as a result of the analysis completed in the previous tasks, presented in an implementation plan.
- Task 6: Final Report – Prepare draft and final Corridor Study report that documents the findings of Tasks 1 to 5.

A Public Involvement Plan was integrated throughout the six tasks and input from the Working Group and public were solicited throughout the process.

Study Area

The first step in the study framework development involved defining Local and Regional Study Areas, depicted in Figure 1-1. The Local Study Area includes Arsenal Street from Watertown Square to Leo Birmingham Parkway, as well as local streets in the vicinity of Arsenal Street and access to developments along Arsenal Street.

The Regional Study Area is more expansive to capture roadways, neighborhoods, and developments which can affect, or are affected by, travel along Arsenal Street. The study includes an analysis of bus service along Arsenal Street and locations where the bus service ties into other crossing bus routes (including Routes 57, 70/70A, 71, and 73). Additional municipalities in the Regional Study Area include Belmont, Newton, Waltham and Cambridge.



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▭ Local Study Area Boundary

▭ Regional Study Area Boundary

▬ Arsenal Street Corridor

Arsenal Street Corridor Study | Watertown, Massachusetts

Local and Regional Study Area

Source: MassGIS

Study Goals, Objectives, and Evaluation Criteria

During the study's initial months, goals, objectives, and evaluation criteria were developed and refined in conjunction with the Working Group. Goals define the general intentions and purposes for conducting the study based on the issues that have to be addressed. Objectives describe ways that the goals could be accomplished. The evaluation criteria are used to qualitatively and quantitatively measure how well each alternative meets the stated goals and objectives.

Through coordination with the Working Group, the following goals for the project were developed:

- Improve mobility and traffic flow
- Enhance safety
- Improve accessibility and connectivity for all modes
- Meet transportation goals while supporting economic development and improving quality of life
- Meet transportation goals while minimizing impacts to the environment
- Develop a range of multimodal recommendations that support ongoing changes and have lasting benefits
- Encourage consensus through an open and inclusive process
- Develop recommendations that target demonstrated needs

Table 1-1 summarizes the objectives and evaluation criteria related to each specific goal.

Table 1-1 Study Specific Goals, Objectives, and Evaluation Criteria

GOAL/OBJECTIVES	EVALUATION CRITERIA
Goal: Improve mobility and traffic flow	
▪ Decrease congestion and reduce delays $^{\text{PHO}}$ ▪ Improve system reliability ▪ Minimize local street impacts ▪ Maintain emergency vehicle and first responder mobility	▪ Average speeds ▪ Delays/Level of service ▪ Travel time improvements ▪ Traffic demands by functional classification ▪ Vehicle-miles traveled (VMT) ▪ Vehicle-hours traveled (VHT) $^{\text{PHO}}$ ▪ Transit on-time performance
Goal: Enhance safety $^{\text{PHO}}$	
▪ Identify, eliminate, or mitigate locations and situations that pose hazards $^{\text{PHO}}$ ▪ Verify that the transportation infrastructure meets current design standards $^{\text{PHO}}$ ▪ Identify structurally deficient infrastructure	▪ 3-year crash data analysis ▪ High crash corridors/locations (vehicles, bikes, pedestrians) $^{\text{PHO}}$ ▪ Geometric design review ▪ Severity of crashes
Goal: Improve accessibility and connectivity for all modes	
▪ Explore ways to reduce auto dependency $^{\text{PHO}}$ ▪ Seek opportunities to improve existing public transportation services $^{\text{PHO}}$ ▪ Coordinate existing transit services ▪ Improve bike and pedestrian connections $^{\text{PHO}}$ ▪ Promote active transportation $^{\text{PHO}}$	▪ Transit travel time improvements ▪ Transit service/schedule enhancements ▪ Mode share $^{\text{PHO}}$ ▪ Expanding ridesharing opportunities $^{\text{PHO}}$ ▪ Quality and location of pedestrian/bicycle accommodations $^{\text{PHO}}$ ▪ Auto ownership
Goal: Meet transportation goals while supporting economic development and improving quality of life	
▪ Support existing and projected economic development ▪ Minimize negative economic effects to tax bases, and seek opportunities to enhance local and regional economic activity where possible ▪ Improve non-motorized access and connectivity between business centers and employment centers $^{\text{PHO}}$ ▪ Improve access to the regional highway system ▪ Avoid/minimize/mitigate social equity impacts ▪ Incorporate healthy community design features $^{\text{PHO}}$	▪ Impacts to businesses (access improvements, VMT, increased jobs creation) ▪ Tax base impacts (effects on jobs and employment) ▪ Impacts to residential/ schools/community facilities $^{\text{PHO}}$ ▪ Qualitative indirect effects on adjacent minority and disadvantaged populations (environmental justice) ▪ Site access/Access management ▪ Reduce travel time, improve wayfinding, enhance system performance reliability $^{\text{PHO}}$ ▪ Prioritize alternatives by identifying their health value $^{\text{PHO}}$ ▪ Consider both short and long-term health benefits $^{\text{PHO}}$

PHO Denotes public health goal, objective, or criteria

Table 1-1 (continued) Study Specific Goals, Objectives, and Evaluation Criteria

GOAL/OBJECTIVES	EVALUATION CRITERIA
Goal: Meet transportation goals while minimizing impacts to the environment	
▪ Support smart growth, anti-sprawl initiatives [PHO] ▪ Avoid/minimize/mitigate impacts to the natural environment ▪ Minimize greenhouse gas emissions [PHO] ▪ Reduce CO and particulate matter impacts [PHO] ▪ Minimize transportation-related noise impacts along the corridor [PHO]	▪ Impacts to natural environment (wetland/habitat/open space/historic areas/conservation areas/others) ▪ Estimated reduction of greenhouse gas emissions [PHO] ▪ Estimated reduction of CO and PM [PHO] ▪ Effects of alternatives on NOx and VOC [PHO] ▪ Effects of alternatives on sound levels [PHO]
Goal: Develop a range of multimodal recommendations that support ongoing changes and have lasting benefits	
▪ Identify solutions that include both short-term and long-term actions to improve traffic flow, mobility and operational efficiency [PHO] ▪ Identify solutions that are cost-effective in the context of state transportation planning ▪ Identify solutions that comply with MAP-21[1] and incorporate sustainable growth principles [PHO] ▪ Identify solutions that meet criteria for federal funding ▪ Identify steps necessary to advance priority projects	▪ Improved level of service, reduced VMT/VHT to 2035 ▪ Mode share, trip distribution by roadway functional classification [PHO] ▪ Preliminary costs ▪ FAST Act[1] compliance and sustainable growth compatibility ▪ Federal agency funding assessment
Goal: Encourage consensus through an open and inclusive process	
▪ Document and consider the input of the Working Group and the public ▪ Attempt to reach reasonable consensus on study recommendations ▪ Keep adjacent communities and the public informed throughout the study ▪ Provide opportunities for public comment throughout the study ▪ Encourage feedback from traditionally underserved population(s)	▪ Develop and implement Public Outreach Plan ▪ Develop study website for public access ▪ Ensure transparency by posting study documents on the website (including meeting notes) ▪ Form a diverse Working Group for the study ▪ Encourage consensus
Goal: Develop recommendations that target demonstrated needs	
▪ Quantify or qualify the needs – such as safety, traffic flow, reliability – as clearly as possible ▪ Provide justification for any additional recommended actions over and above what analyses show is necessary	▪ Documentation of analyses and recommendations throughout the study (Task 1 through Task 6)

PHO Denotes public health goal, objective, or criteria

[1] Fixing America's Surface Transportation (FAST) Act was passed by Congress in December 2015 and replaces the transportation funding bill known as MAP-21.

Public Health

As noted in the goals, objectives, and evaluation criteria discussion in Chapter 1, public health is incorporated into many different criteria used to assess the alternatives developed. The alternatives analysis discussion below speaks specifically to the potential benefits or impacts of public health. This section outlines the specific methodology used to qualify benefits/impacts based on available data.

Public Health Assessment Criteria

The public health assessment criteria are developed based upon research review of healthy community design principles and the existing conditions public health analysis of the Arsenal Street Corridor, particularly the public health contributors and barriers identified in Chapter 2. The purpose of the criteria is to help understand:

1. Whether the alternatives enhance the existing public health contributors and/or create additional contributing effects, such as:
    - Enhance existing bus services and increase bus service capacity
    - Enhance transit connectivity with nearby communities and the regional transit systems
    - Improve pedestrian facilities and increase walking in the corridor
    - Improve bicycle facilities and increase biking in the corridor
    - Enhance traffic control at intersections
    - Encourage mixed land uses along the corridor
    - Enhance safe pedestrian and bicyclist connections to community amenities in the corridor (trails, parks and open spaces, schools, health care facilities, health food establishments, community/cultural facilities, retail establishments, businesses, employment centers, etc.)

2. Whether the alternatives mitigate or eliminate the negative impacts of the existing public health barriers, such as:
    - Increase bus service capacity
    - Improve bus stop amenities
    - Improve pedestrian safety and accessibility
    - Reduce automobile accidents
    - Reduced curb cuts
    - Reduce congestion and delay
    - Reduce traffic volume
    - Encourage mixed land uses

The assessment criteria are structured in a way that they address specific public health related objectives established for the Arsenal Street Corridor Study. These criteria intend to offer qualitatively measurable indexes that can be used to assess how each alternative can contribute to the overall goals and objectives upon successful design and implementation. Below is a list of public health related objectives and their corresponding public health assessment criteria.

Objectives on mobility and connectivity:

- Decrease congestion and reduce delays
    - Assessment Criteria: alternatives will be evaluated based on whether their implementation will result in…
        - Reduced vehicle hours traveled
        - Reduced traffic queuing
        - Reduced vehicle idling
- Improve non-motorized access and connectivity to community amenities (trails, parks and open spaces, schools, health care facilities, health food establishments, community/cultural facilities, retail establishments, businesses, employment centers, etc.)
    - Assessment Criteria: alternatives will be evaluated based on whether their implementation will result in…
        - Improved walking and biking facilities
        - Improved connections to existing community amenities
        - Improved pedestrian-scale wayfinding signage
        - Reduced pedestrian, bicycle, and vehicle conflicts, such as at intersections, crosswalks, and curb cuts
        - Increased walking activities
        - Increased biking activities

Objectives on healthy transportation options:

- Reduce auto dependency
- Improve existing public transportation services
- Improve bike and pedestrian connections
- Promote active transportation
    - Assessment Criteria: alternatives will be evaluated based on whether their implementation will result in…
        - Improved bus stop facilities
        - Increased bus services and ridership
        - Improved/safer walking facilities
        - Improved/safer biking facilities
        - Improved walking and biking connections to community destinations
        - Improved transitions among different modes of traveling

Objectives on air quality and Greenhouse Gas (GHG):

- Minimize GHG emissions
- Reduce CO and particulate matter impacts

  - Assessment Criteria: alternatives will be evaluated based on whether their implementation will result in…
    - Reduced vehicle miles travelled
    - Reduced vehicle idling
    - Reduced vehicle slowing and accelerating
    - Reduced emission of GHG

Objective on noise level:

- Minimize transportation-related noise impacts along the corridor
  - Assessment Criteria: alternatives will be evaluated based on whether their implementation will result in…
    - Reduced vehicle traveling speed
    - Reduced vehicle miles traveled

Objectives on public safety:

- Identify, eliminate, or mitigate locations and situations that pose hazards
  - Assessment Criteria: alternatives will be evaluated based on whether their implementation will result in…
    - Reduced pedestrian, bicycle, and vehicle conflicts
    - Reduced automobile accidents
    - Improved/safer walking facilities
    - Improved/safer biking facilities
- Address current design standard deficiencies
  - Assessment Criteria: alternatives will be evaluated based on whether their implementation will result in…
    - Improved transportation infrastructures that meet current design standards
    - Improved system performance efficiency and reliability

Objectives on healthy and sustainable community design:

- Incorporate healthy community design features
  - Assessment Criteria: alternatives will be evaluated based on whether their implementation will result in…
    - Improved opportunities for recreation and physical activity
    - Improved non-motorized access to various community amenities
    - Improved access to public transportation options
    - Improved public safety
    - Improved streetscape designs, such as shade trees and landscaping
    - Improved air quality and traffic noise levels
- Support smart growth, anti-sprawl initiatives
  - Assessment Criteria: alternatives will be evaluated based on whether their implementation will result in…

- Reduced vehicle miles traveled
- Increased mixed use and human-scale developments
- Improved opportunities for non-motorized travel

The outcome for the assessment of each alternative is discussed below.

Public Involvement Plan

Public outreach and involvement were key components of each study task. As discussed in the introduction, an extensive Public Involvement Plan was implemented to ensure an open, transparent, and collaborative study process and included a variety of outreach strategies such as Working Group and public meetings at key project milestones and internet and print communications.

Working Group and public informational meetings at key decision making points engaged stakeholders and the public and provided a forum to solicit opinions and feedback. Meeting materials and summaries from each of the public informational meetings are included in the Appendix. Table 1-2 summarizes the overall study outreach program.

To further ensure constant information exchange, a study website[1] was established to highlight study information including scope, study area, schedule, progress, and contacts for more information. All meeting notes, presentation materials, and study reports were posted on the study website and were compliant with Web Content Accessibility Guidelines 2.0 and Section 508 of the Rehabilitation Act. The website allowed visitors sign up to receive email updates from the project team.

Public comments and questions were welcomed through the website or email, via mail, or at public or Working Group meetings throughout the course of the study and during the 30-day public comment period on the Final Report.

Additional electronic communications included email blasts and social media posts on the MassDOT blog, Facebook, Twitter, YouTube, and Flickr accounts (by MassDOT) to publicize Working Group and public information meetings, and other project updates. Given the large Armenian population located within Watertown, meeting notices were translated into Armenian to capture input from potentially non-English speaking populations.

The project team worked with several community resources to ensure that the public process could be as inclusive as possible. The study website allowed users to translate content into other languages. All public meeting notices were available in Armenian, a non-English language spoken predominantly throughout the area. All meetings were

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[1] https://www.mass.gov/massdot/arsenalstreet

held in locations accessible by people with disabilities and audio/visual aids known as Computer Aided Real Time transcription (CART) were made available upon request.

Table 1-2 Study Outreach Program

Meeting	Date	Topics
Working Group Meeting 1	September 30, 2015	Study kick-off; review study area, goals/objectives, evaluation criteria, and public participation plan
Working Group Meeting 2	January 26, 2016	Review existing conditions evaluations (transit, traffic, safety, bike/pedestrian, land use and economic development, environmental resources, public health); 2040 future conditions discussions
Public Informational Meeting 1	February 24, 2016	Study kick-off; review study area, goals/objectives, evaluation criteria, and public participation plan; review existing conditions evaluations
Working Group Meeting 3	June 28, 2016	2040 future conditions forecasts, transit, and traffic analysis; evaluation of issues/opportunities; constraints identification; preliminary alternatives development
Working Group Meeting 4	August 3, 2016	Alternatives development and screening; preliminary alternatives analysis
Public Informational Meeting 2	October 4, 2016	2040 future conditions forecasts, transit, and traffic analysis; evaluation of issues/opportunities; constraints identification; alternatives development and screening
Working Group Meeting 5	January 24, 2017	Alternatives analysis; preliminary recommendations
Working Group Meeting 6	March 2, 2017	Study recommendations; Final Report
Public Informational Meeting 3	June 2017	Alternatives analysis; study recommendations

2

Existing Conditions

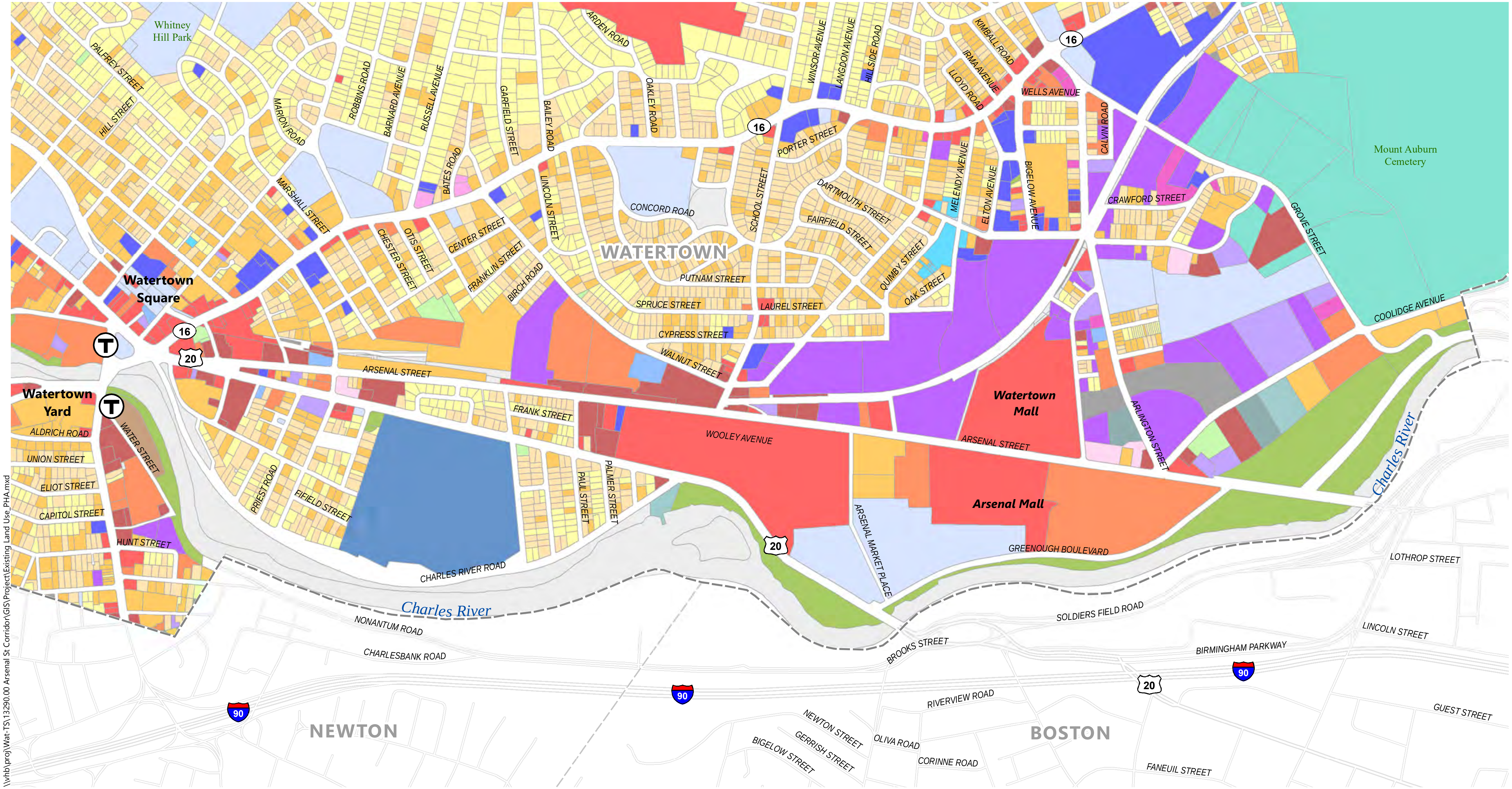
This chapter provides an assessment of Existing Conditions within the study area. Sections of this chapter present demographics, environmental resources, land use and economic development, a multimodal transportation assessment, and a summary of the transportation infrastructure deficiencies and needs as of winter 2016.

Land Use

The Local Study Area contains nearly 1,820 separate parcels comprising approximately 442 acres of land. There is nearly 9.2 million square feet of development in this Corridor, containing a mix of residential, commercial, retail and other uses, as shown in Figure 2-1. The assessed value (2015) of these properties equates to approximately $1.6 billion. A detailed land use evaluation (including expanded information on the data above) is included in the Appendix and key takeaways from the analysis include:

- Retail developments comprise approximately 1.13 million square feet of the parcels fronting Arsenal Street. The retail uses in the frontage parcels account for approximately 88 percent of all retail development in the Local Study Area, likely reflecting favorable traffic and location characteristics of Arsenal Street. The average assessed value (per square foot) of retail properties is similar between the Frontage Parcels and the Local Study Area.
- Industrial parcels with Arsenal Street frontage comprise 251,200 square feet and are primarily warehouse space. By comparison, there is more than 1.35 million square feet of industrial space throughout the Local Study Area, perhaps reflecting a lesser desirability for these uses (or a stronger desirability for other industrial uses) on Arsenal Street or a lack of suitable land (sites) for development. The warehouse space that exists could represent the historic

Apr 03, 2017 | **FIGURE 2-1**



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Existing Land Use

- Single Family
- Two Family
- Other Residential
- Retail Trade
- Automotive Sales and Services
- Office
- Indoor Recreation
- Outdoor Recreation
- Manufacturing and Processing
- Storage and Distribution Facilities
- Utility
- Public Service Properties
- Child Care Facilities
- Hotels and Nursing Homes
- Private Schools
- Non-profit and Religious
- Cemeteries
- Vacant Land - Developable
- Vacant Land - Undevelopable
- State - DCR
- State - Other
- Housing Authority
- Town-owned
- Other

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Existing Land Use

Source: MassGIS, Town of Watertown

- nature and uses of development associated with the Arsenal, which zoning has not adjusted since its departure.
- Residential uses among the frontage parcels represent about five percent of the residential uses in the Local Study Area, both in terms of acreage and in terms of square feet of development. However, the average assessed value of single family residential and condominiums among frontage parcels, are both above those values for the Local Study Area residential uses, at 119 percent and 124 percent, respectively (albeit from a limited count of such uses on Arsenal Street).
- About one-half of the Local Study Area commercial development, at 520,500 square feet, is among the Frontage parcels. The average assessed value of these parcels, at $390 per square foot, is 53 percent greater than for the Local Study Area as a whole.

Socio-Economics

This section provides an overview of the relevant transportation-related socio-economic indicators and demographics for the study area. Key indicators such as population, households, and employment are directly relevant to transportation demands and are the primary parameters used in travel demand forecasting models.

Estimated population, housing, and employment levels for the Arsenal Street Corridor for the years 2010 and 2015 are summarized in Table 2-1.

Table 2-1 Local Study Area Socio-Economic Indicators

Indicator	2010 Census[1]	2015 Estimate[2]	Percent Growth
Population	5,504	5,708	3.7%
Household Units	2,740	2,471	-0.1%
Employees	n/a	6,630	n/a

1 2010 U.S. Census

2 Based on US Census, Alteryx, Dun and Bradstreet, and RKG Associates, Inc.

A complete market analysis of both the Local Study Area (the Arsenal Street Corridor) and the Regional Study Area is presented in the Appendix. Key findings of this analysis are summarized below.

Demographic Indicators

Analysis of population trends from 2010 to 2015 indicate:

- The estimated population of the Local Study Area was 5,700 persons in 2015, representing an increase of 200 people since 2010. Total population in the

Regional Study Area has grown by slightly more than four percent over the 2010 to 2015 time (similar to the Local Study Area).

- In 2015, three-fourths of the population in both the Local and Regional Study Areas identifies as white, with five percent or less of the population identifies as black. More than 15 percent of the population of each identified themselves as "Other." Persons of Hispanic/Latino heritage identified themselves as 7.6 percent of the Local Study Area population and 8.5 percent of the Regional Study Area population.
- The Local and Regional Study Area populations aged 65 and older increased by 6.2 percent and 5.4 percent between 2010 and 2015, respectively.
- Conversely, the population aged 15 to 24 years has declined in the Local Study Area by 3.1 percent between 2010 and 2015. Similarly, the Region has lost 0.4 percent of population aged 15 to 24 years over the same timeframe.

Housing Indicators

Analysis of housing trends from 2010 to 2015 indicate:

- Between 2010 and 2015, the total number of housing units in the Local Study Area remained constant. Unlike the Local Study Area, there was a 1.4 percent growth in total housing units in the Region between 2010 and 2015.
- Current housing in the Local Study Area reflects a mix of 60 percent renter occupancy and 40 percent owner occupancy. Tenure characteristics for the Region indicate 55 percent renter occupancy and 45 percent owner occupancy.
- The Local Study Area's mean household income (2015) is nearly $100,000 and the median household income is approximately $75,700. The Region's mean and median household incomes are slightly higher at nearly $111,400 and $78,800, respectively.
- In 2015, slightly more than 73 percent of the Corridor households were comprised of one or two persons, with an average household size of 2.08 persons and an average of 1.64 vehicles per household. Most of the 2015 households in the Region are either single person households (37 percent) or two person households (34 percent) with an average household size of 2.13 persons (slightly larger than in the Corridor). In 2015, approximately 16 percent of the Region households had no vehicle available.

Employment Indicators

Employment and labor force analysis indicates:

- The Watertown labor force averaged 20,817 persons (aged 16 and over) during the October 2014 through October 2015 period. Employment during this period averaged 20,119 persons, indicating average monthly unemployment of nearly 700 persons; an average unemployment rate of 3.4 percent.
- Since October 2014, the unemployment rate for Watertown has consistently been lower than that for the Metro North Workforce Investment Area (WIA), Massachusetts and the United States.
- In 2015, the approximate 6,630 employees in the Local Study Area represented 13 percent of the 50,800 employees in the Region. The greatest concentration of employment in the Local Study Area is among industry sectors with an institutional use, including health and education services (35 percent).
- Employment in the health sector in the Local Study Area represents slightly more than 21 percent of the health sector employment in the Region. Retail employment in the Local Study Area is also very strong, accounting for 29 percent of Regional retail employment.
- Employment in the finance/insurance industry in the Local Study Area accounts for less than one percent of that sector's employment in the Region.
- The 2015 daytime population in the Local Study Area (aged 16+ years) is nearly 8,120 persons, of which nearly 6,500 persons are at their workplace. The estimated resident population is 5,700 persons. Therefore, the Local Study Area is a net employment importer.
- Major employers along the Arsenal Street Corridor include athenahealth, tenants of the Arsenal Mall, Lexus of Watertown, Enanta Pharmaceuticals, Harvard Vanguard Medical (Atrius Health) and VHB.

Journey-to-Work and Mode Share

This section provides an overview of journey-to-work and mode share data for the study area. The data provides an insight to commuting patterns and mode choice that are useful in forecasting and future planning purposes.

Journey-to-Work

Journey-to-work data from the 2006-2010 U.S. Census is used to show the key origin and destination trip patterns. The journey-to-work data provide a wealth of information on commuting patterns and trends and is useful in travel demand modeling and forecasting.

Table 2-2 summarizes the daily work trips that occur for residents in Watertown, work trips within Watertown and work trips to the top communities (where percent of total trips is greater than one percent).

Table 2-2 Daily Work Trip Generation FROM Watertown, MA (Home-Based)

City/Town	Number of Trips	Percent of Trips
Boston	4,986	27%
Watertown	3,405	18.4%
Cambridge	2,002	10.8%
Waltham	1,171	6.3%
Newton	1,006	5.4%
Belmont	667	3.6%
Lexington	299	1.6%
Somerville	285	1.5%
Wellesley	278	1.5%
Needham	265	1.4%
Framingham	231	1.2%
Brookline	224	1.2%
Burlington	202	1.1%
Others (less than 1%)	3,462	19%
Total Trips	18,483	100%

Source: U.S. Census Bureau, 2006-2010 American Community Survey

The key home-based commuting trends are as follows:

- Based on the U.S. Census data, a total of 18,483 daily work trips originate from the Town of Watertown. Of these, 3,405 work trips, or 18.4 percent, are within Watertown.
- The city of Boston has the highest work trip generation (4,986 trips).
- Thirteen communities (including Watertown) have work trips that are higher than one percent of total work trips.

Table 2-3 summarizes the daily work trips that enter Watertown, showing the total work trips, work trips within Watertown, and work trips that originate from top communities (percent of trips greater than one percent of total trips).

Table 2-3 Daily Work Trip Generation TO Watertown, MA (Work-Based)

City/Town	Number of Trips	Percent of Trips
Watertown	3,405	17.4%
Boston	3,118	15.9%
Waltham	1,468	7.5%
Newton	822	4.2%
Cambridge	813	4.2%
Belmont	485	2.5%
Everett	407	2.1%
Arlington	381	1.9%
Framingham	344	1.8%
Medford	342	1.7%
Brookline	325	1.7%
Somerville	304	1.6%
Natick	298	1.5%
Malden	260	1.3%
Woburn	212	1.1%
Others	6,591	33.7%
Total	19,575	100%

Source: U.S. Census Bureau, 2006-2010 American Community Survey

From Table 2-3, key work-based commuting trends to Watertown are as follows:

- A total of 19,575 daily work trips are destined for Watertown. Of these, 3,405 work trips are internal (within Watertown).
- Fifteen communities (including Watertown) have work trips that are higher than one percent of all work trips.

These journey-to-work trip characteristics are important fundamental considerations for modeling existing and forecasted conditions.

Mode Share

Understanding how people get to and from work in the study area is an important initial step of the transportation system deficiencies and needs. An evaluation of mode choice using the US Census data helps measure auto-dependency.

Table 2-4 and Figure 2-2 summarize the mode share for people who live in Watertown from the 2010 Census. As shown, the majority of Watertown residents (over 70 percent) either drive alone or carpool to work. Transit is the second most prevalent mode, with 15 percent of residents relying on transit for their commute to and from work. The percentage of residents that bike or walk to work is at three percent, while telecommuters, or residents who regularly work from home, account for four percent of total trips.

Table 2-4 Mode Choice for Watertown Residents (Home-Based)

Mode	Number of Residents	Percent of Residents
Single- Occupant Automobile	12,495	68%
Multiple - Occupant Automobile	1,705	9%
Transit	2,730	15%
Bicycle/Walk	625	3%
Work at Home	820	4%
Other	120	1%
Total	18,495	100%

Source: U.S. Census Bureau, American Community Survey 2006-2010 Five-year estimates. Special Tabulation: Census Transportation Planning

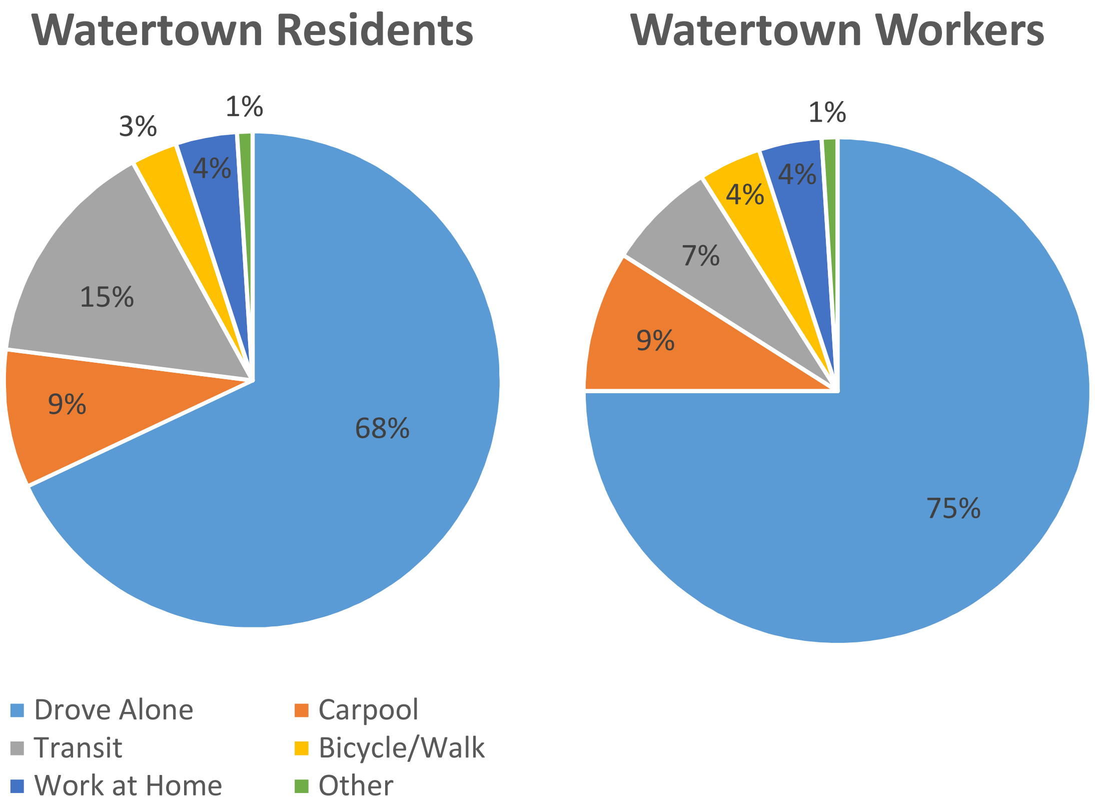
Table 2-5 and Figure 2-2 summarize the mode share for workers that are employed in Watertown based on the 2010 Census. Much like other communities and throughout the US, there is a strong reliance on the automobile and lower on transit use.

Table 2-5 Mode Choice for Watertown Workers (Work-Based)

Mode	Number of Residents	Percent of Residents
Single- Occupant Automobile	14,665	75%
Multiple - Occupant Automobile	1,730	9%
Transit	1,440	7%
Bicycle/Walk	750	4%
Work at Home	820	4%
Other	175	1%
Total	18,495	100%

Source: U.S. Census Bureau, American Community Survey 2006-2010 Five-year estimates. Special Tabulation: Census Transportation Planning

As shown, over 80 percent of workers either drive alone or carpool to work. The number of workers that travel to Watertown via transit accounts for seven percent of total workers. The percentage of workers that bike or walk to work is at four percent, while telecommuters and employees who regularly work from home accounts for four percent of total workers.



Source: U.S. Census Bureau, American Community Survey 2006-2010.

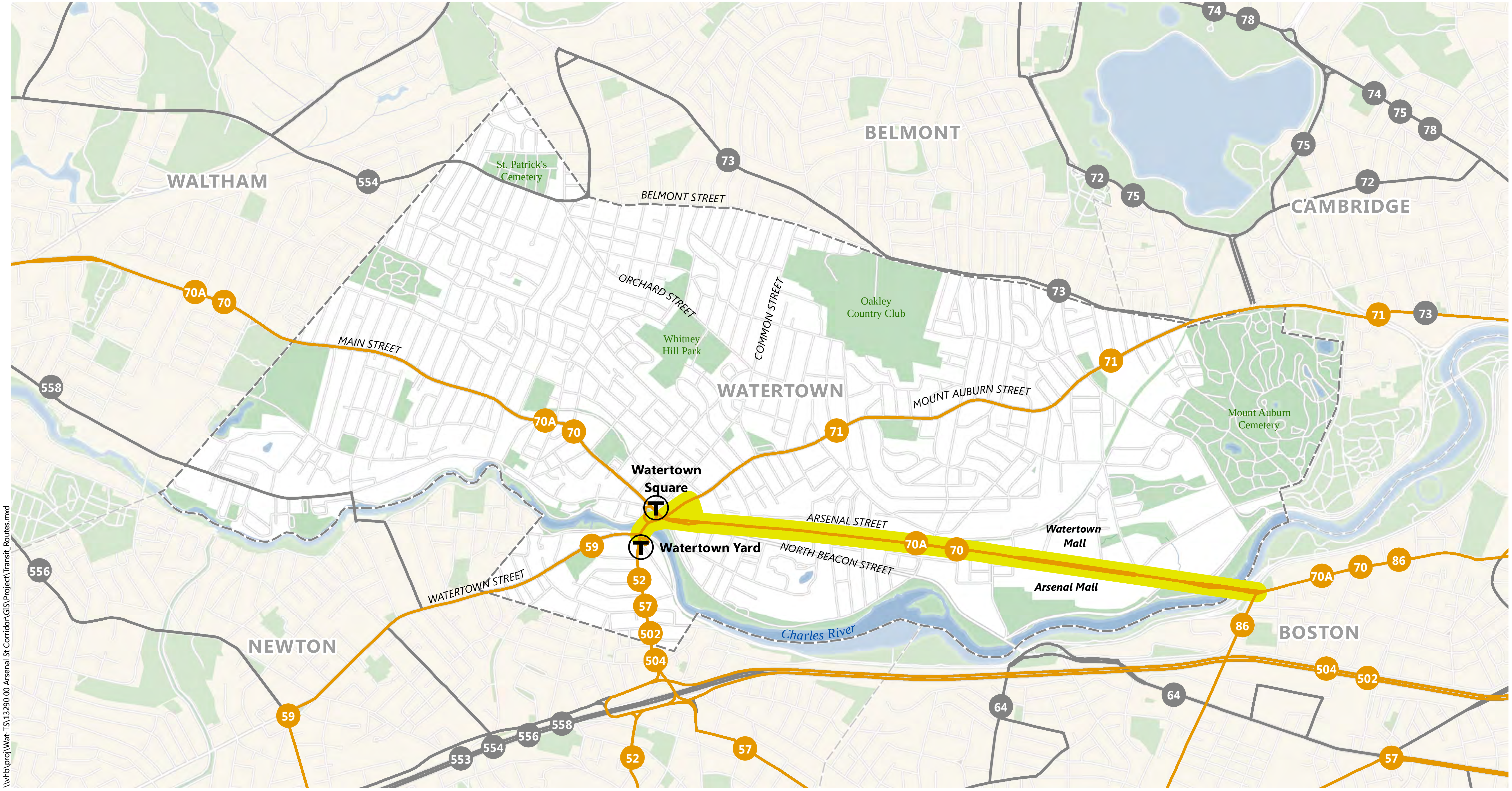
Figure 2-2 Mode Share for Watertown Residences and Workers

Transit Services

Existing transit service along and connecting to the Arsenal Street Corridor is provided by the Massachusetts Bay Transportation Authority (MBTA), the Boston Metropolitan Region's public transit operator. The MBTA operates seven local bus routes and two express bus routes within the Regional Study Area. Two local bus routes, 70 and 70A, run the length of the Arsenal Street Corridor. The seven remaining routes connect with the corridor either on the west end, at Watertown Square or the adjacent Watertown Yard, or on the east end at Western Avenue.

Figure 2-3 illustrates the Arsenal Street Corridor and the transit services operating within the Study Area. Additional detail on the specific routes serving the Study Area are provided below and in the following sections:

Apr 03, 2017 | **FIGURE 2-3**



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— # — Study Area MBTA Bus Routes

— # — Other MBTA Bus/Trackless Trolley Routes

▬ Arsenal Street Corridor

Arsenal Street Corridor Study | Watertown, Massachusetts

Existing MBTA Transit Routes

Source: MassGIS

- **Route 52** operates on weekdays only from Dedham Mall or Charles River Loop to Watertown Yard via VFW Parkway, Baker Street, Parker Street, and Centre Street. The route provides service in Dedham, Boston, Newton, and Watertown, and provides a connection to MBTA Green Line D Branch rapid transit service at Newton Centre. Route 52 has two separate route variations in Newton along Winchester Street and Wheeler Road.
- **Route 57** operates daily from Watertown Yard to Kenmore Station via Tremont Street, Washington Street, and Commonwealth Avenue. The route provides service in Watertown, Newton, and Boston, and provides connections to the MBTA Green Line B Branch rapid transit service between Packards Corner and Kenmore. Route 57 has a short turn service that does not serve the Study Area, referred to as the 57A, which runs from Oak Square to Kenmore Station.
- **Route 59** operates daily from Needham Junction to Watertown Square via Chestnut Street, Highland Avenue, Walnut Street, and Watertown Street. The route provides service in Needham, Newton, and Watertown. Connections to MBTA Needham Line commuter rail service are provided at Needham Junction, Needham Center, and Needham Heights, connections to MBTA Green Line D Branch rapid transit service are provided at Newton Highlands, and connections to MBTA Worcester Line commuter rail service are provided at Newtonville. Route 59 has one route variation in Newton that serves Needham Street.
- **Route 70** operates daily from Cedarwood or Central Square in Waltham to University Park in Cambridge via Main Street, Arsenal Street, and Western Avenue. The route provides service in Waltham, Watertown, Boston, and Cambridge. Connections to MBTA Fitchburg Line commuter rail service are provided at Waltham and connections to MBTA Red Line rapid transit service are provided at Central Square.
- **Route 70A** operates six days a week from North Waltham to University Park via Main Street, Arsenal Street, and Western Avenue. The route provides service in Waltham, Watertown, Boston, and Cambridge. In the North Waltham area, Route 70A operates with several route variants depending on direction and time of day. Connections to MBTA Fitchburg Line commuter rail service are provided at Waltham and connections to MBTA Red Line rapid transit service are provided at Central Square.
- **Route 71** operates daily from Watertown Square to Harvard Station via Mt. Auburn Street. The route provides service in Watertown and Cambridge, and provides connections to MBTA Red Line rapid transit service at Harvard Station. Route 71 operates using trolley buses every day except Sunday, when diesel buses replace the trolley buses.
- **Route 86** operates daily from Sullivan Square Station to Reservoir Station at Cleveland Circle via Washington Street, JFK Street, Western Avenue, and

Market Street. The route provides service in Somerville, Cambridge, Boston, and Brookline. Connections to MBTA Orange Line rapid transit service are provided at Sullivan Square, connections to MBTA Red Line rapid transit service are provided at Harvard, and connections to MBTA Green Line rapid transit services are provided to the B Branch at Chestnut Hill Avenue, to the C Branch at Cleveland Circle, and to the D Brach at Reservoir.

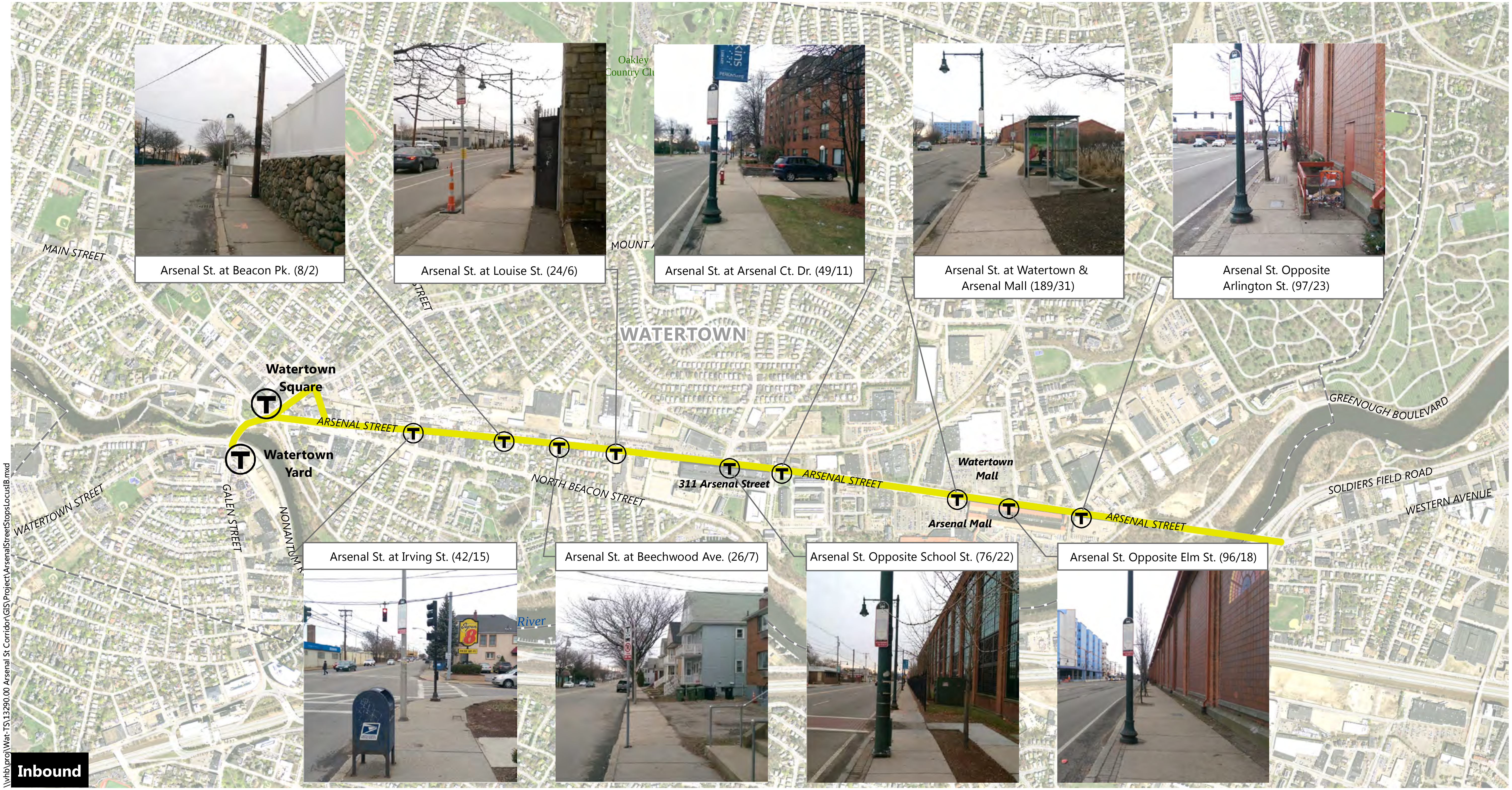
- **Route 502** is an express service that operates weekdays from Watertown Yard to Copley Square via the Massachusetts Turnpike, providing bus service between the Study Area and the Back Bay in Boston. Route 502 operates in both directions during the peak periods only.
- **Route 504** is an express service that operates six days a week from Watertown Yard to Federal Street and Franklin Street in Downtown Boston via the Massachusetts Turnpike. Route 504 operates with increased service during the peak periods.

The MBTA operates three types of buses within the Study Area, including Compressed Natural Gas (CNG) and diesel buses, as well as electric trolley buses. Only diesel buses operate along the Arsenal Street Corridor. These buses are standard 40-foot long buses with a seated capacity of 39 passengers. All of the MBTA’s buses are equipped with wheelchair lifts or ramps.

Study Area Bus Stops

Along the Arsenal Street Corridor, there are nine inbound bus stops located on the southern side of Arsenal Street and ten outbound stops located on the northern side, as illustrated in Figure 2-4 and Figure 2-5 respectively. Many of the bus stops located on Arsenal Street do not have formal shelters and consist of a posted sign along the existing sidewalk to designate the bus stop. In some locations, these bus stops are on narrow sidewalks which provide no additional space for waiting passengers outside the path of pedestrians. The inbound and outbound bus stops located at the Watertown and Arsenal Malls have single, standard covered bus shelters. The bus stops along the corridor and their associated facilities are outlined in Table 2-6.

Apr 03, 2017 | **FIGURE 2-4**


Arsenal St. at Beacon Pk. (8/2)
Arsenal St. at Louise St. (24/6)
Arsenal St. at Arsenal Ct. Dr. (49/11)
Arsenal St. at Watertown & Arsenal Mall (189/31)
Arsenal St. Opposite Arlington St. (97/23)
Arsenal St. at Irving St. (42/15)
Arsenal St. at Beechwood Ave. (26/7)
Arsenal St. Opposite School St. (76/22)
Arsenal St. Opposite Elm St. (96/18)
Oakley Country Clu
MAIN STREET
MOUNT
STREET
WATERTOWN
Watertown Square
Watertown Yard
ARSENAL STREET
NORTH BEACON STREET
311 Arsenal Street
Watertown Mall
Arsenal Mall
GREENOUGH BOULEVARD
SOLDIERS FIELD ROAD
WESTERN AVENUE
WATERTOWN STREET
GALEN STREET
NONANTUM
River
Inbound

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↑ 0 250 500 1000 Feet

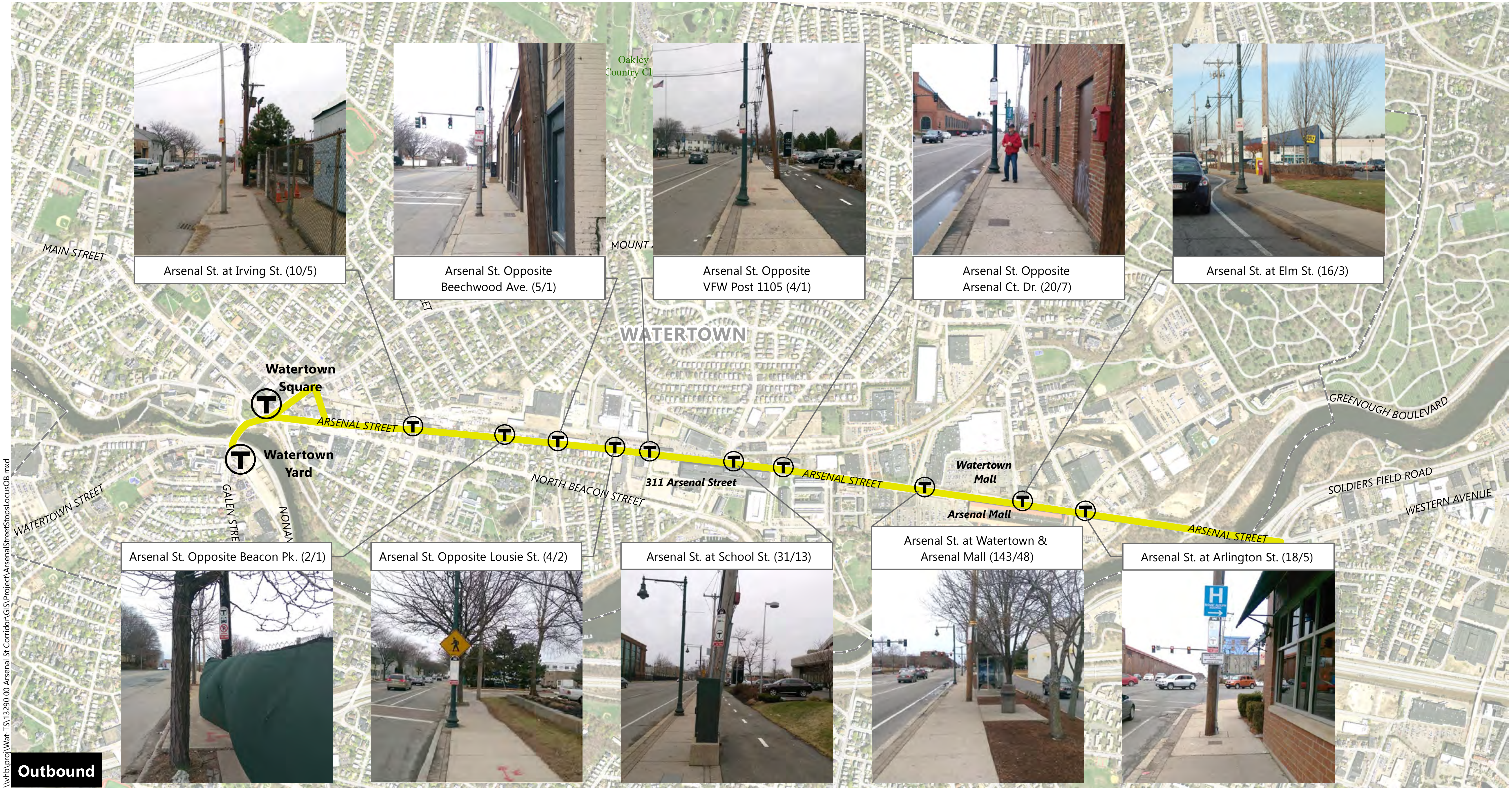
Bus Stop Name
(Route 70 Daily Boardings/ Route 70A Daily Boardings)

Ⓣ Bus Stop

🟨 Arsenal Street Corridor

Arsenal Street Corridor Study | Watertown, Massachusetts

MBTA Routes 70/70A
Arsenal Street Inbound
Bus Stop Locus Map
Source: MassGIS, MBTA


Arsenal St. at Irving St. (10/5)
Arsenal St. Opposite Beechwood Ave. (5/1)
Arsenal St. Opposite VFW Post 1105 (4/1)
Arsenal St. Opposite Arsenal Ct. Dr. (20/7)
Arsenal St. at Elm St. (16/3)
Oakley Country Club
MAIN STREET
MOUNT
WATERTOWN
Watertown Square
ARSENAL STREET
Watertown Yard
NORTH BEACON STREET
311 Arsenal Street
Watertown Mall
Arsenal Mall
GREENOUGH BOULEVARD
SOLDIERS FIELD ROAD
WESTERN AVENUE
WATERTOWN STREET
GALEN STREET
NONANTUM
Arsenal St. Opposite Beacon Pk. (2/1)
Arsenal St. Opposite Lousie St. (4/2)
Arsenal St. at School St. (31/13)
Arsenal St. at Watertown & Arsenal Mall (143/48)
Arsenal St. at Arlington St. (18/5)
Outbound

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↑

0 250 500 1000 Feet

Bus Stop Name
(Route 70 Daily Boardings/ Route 70A Daily Boardings)

Ⓣ Bus Stop

▬ Arsenal Street Corridor

Arsenal Street Corridor Study | Watertown, Massachusetts

MBTA Routes 70/70A
Arsenal Street Outbound
Bus Stop Locus Map

Source: MassGIS, MBTA

Table 2-6 Arsenal Street Corridor Bus Stops

Bus Stop Name	Direction	Bus Stop Location	Stop Facilities
Arsenal St. @ Arlington St.	Outbound	Near-Side	Sign Post
Arsenal St. @ Elm St.	Outbound	Far-Side	Sign Post
Arsenal St. @ Watertown + Arsenal Mall	Outbound	Mid-Block	One Bus Shelter
Arsenal St. Opposite Arsenal Ct. Dr.	Outbound	Mid-Block	Sign Post
Arsenal St. @ School St.	Outbound	Far-Side	Sign Post
Arsenal St. Opposite VFW Post 1105	Outbound	Mid-Block	Sign Post
Arsenal Street Opposite Louise St.	Outbound	Mid-Block	Sign Post
Arsenal St. Opposite Beechwood Ave.	Outbound	Near-Side	Sign Post
Arsenal St. Opposite Beacon Park	Outbound	Mid-Block	Sign Post
Arsenal St. @ Irving St.	Outbound	Mid-Block	Sign Post
Arsenal St. @ Irving St.	Inbound	Near-Side	Sign Post
Arsenal St. @ Beacon Park	Inbound	Near-Side	Sign Post
Arsenal St. @ Beechwood St.	Inbound	Far-Side	Sign Post
Arsenal St. @ Louise St.	Inbound	Mid-Block	Sign Post
Arsenal St. Opposite School St.	Inbound	Mid-Block	Sign Post
Arsenal St. @ Arsenal Ct. Dr.	Inbound	Mid-Block	Sign Post
500 Arsenal St. @ Watertown + Arsenal Mall	Inbound	Far-Side	One Bus Shelter
Arsenal St. Opposite Elm St.	Inbound	Mid-Block	Sign Post
Arsenal St. Opposite Arlington St.	Inbound	Mid-Block	Sign Post

Source: Names from MassGIS MBTA Bus Stops Datalayer; All other information from field visits by VHB

Operations

The following sections describe the operational characteristics of the existing transit services within the project Study Area.

Span of Service and Frequency

MBTA bus routes serve the Study Area seven days a week, however, not all bus routes offer off-peak, late night, or weekend service. A span of service summary showing operating times for buses within the Study Area (operating along or connecting to the Arsenal Street Corridor) is shown in Table 2-7. These times are based on currently published schedules, valid from September 5, 2015 to December 25, 2015.

Table 2-7 Study Area Bus Span of Service

Route	Weekday	Saturday	Sunday
52	6:15 a.m. - 7:57 p.m.	Does not Operate	Does not Operate
57	4:33 a.m. - 2:35 a.m.	4:33 a.m. - 2:38 a.m.	6:00 a.m. - 1:32 a.m.
59	6:05 a.m. - 8:21 p.m.	7:05 a.m. - 7:35 p.m.	7:50 a.m. - 6:51 p.m.
70	4:50 a.m. - 1:19 a.m.	5:00 a.m. - 1:27 a.m.	6:00 a.m. - 1:22 a.m.
70A	5:30 a.m. - 8:22 p.m.	7:05 a.m. - 8:43 p.m.	Does not Operate
71	4:51 a.m. - 1:40 a.m.	4:57 a.m. - 1:36 a.m.	6:30 a.m. - 1:22 a.m.
86	5:00 a.m. - 1:07 a.m.	5:00 a.m. - 1:02 a.m.	7:30 a.m. - 10:05 a.m.
502	6:45 a.m. - 7:22 p.m.	Does not Operate	Does not Operate
504	6:20 a.m. - 8:09 p.m.	7:30 a.m. - 8:04 p.m.	Does not Operate

Source: MBTA Bus Timetables (valid from 9/5/15 to 12/25/15), accessed from www.mbta.com on 12/1/15.

Approximate service frequencies for each time period and day of the week are shown for each route operating in the Study Area in Table 2-8. These frequencies are based on the currently published schedules, valid from September 5, 2015 to December 25, 2015.

Table 2-8 Study Area Bus Frequency (Minutes)

	Weekday					Weekend	
	Early AM & AM Peak	Midday Base & Midday School	PM Peak	Evening	Late Evening & Night/Sunrise	Saturday Peak	Sunday Peak
Route	6:00 a.m. – 8:59 a.m.	9:00 a.m. – 3:59 p.m.	4:00 p.m. – 6:29 p.m.	6:30 p.m.- 9:59 p.m.	10:00 p.m. – 5:59 a.m.	Varies	Varies
52	30	60	35	35	n/a	n/a	n/a
57	6	10	6	10	20	10	15
59	35	45	35	35	n/a	90	90
70	15	25	15	25	35	20	25
70A	30	65	30	30	n/a	40	n/a
71	10	15	10	15	20	15	20
86	15	20	15	30	45	30	35
502	6	n/a	12	n/a	n/a	n/a	n/a
504	10	30	10	25	n/a	35	n/a

Source: MBTA Bus Timetables (valid from 9/5/15 to 12/25/15), accessed from www.mbta.com on 12/1/15.

Ridership

Existing transit ridership within the Study Area was analyzed using Fall 2014 data provided by the MBTA, the most current data available at the time of the existing conditions analysis. Average daily ridership totals for each line operating through the

Study Area are provided in Table 2-9 and represent the average daily boardings along the entire line, including boardings outside of the Arsenal Street Corridor. The inbound and outbound directions indicated in Table 2-9 are as defined in the current MBTA schedules. For routes serving Boston, inbound routes travel towards Boston. For Route 59, inbound is defined as traveling from Needham to Watertown, while Route 52, inbound is defined as traveling from Dedham Mall to Watertown. For Route 86, inbound is defined as traveling from Sullivan Square to Reservoir Station.

Table 2-9 Average Weekday Boardings for Routes Serving the Study Area

	Weekday			Saturday			Sunday		
Route	Inbound	Outbound	Total	Inbound	Outbound	Total	Inbound	Outbound	Total
52	340	368	708	n/a	n/a	n/a	n/a	n/a	n/a
57	5,007	5,360	10,367	3,909	3,643	7,552	2,598	2,379	4,977
59	731	731	1,462	208	237	445	143	182	325
70	2,733	2,818	5,551	1,913	2,091	4,004	1,842	1,870	3,712
70A[a]	810	1,192	2,002	745	829	1,574	n/a	n/a	n/a
71[b]	2,690	2,858	5,548	1,618	1,504	3,122	1,079	873	1,952
86	2,582	3,045	5,627	1,376	1,659	3,035	928	1,091	2,019
502	568	437	1,005	n/a	n/a	n/a	n/a	n/a	n/a
504	821	661	1,482	243	217	460	n/a	n/a	n/a

Source: Fall 2014 Bus Ridership Data (provided by MBTA)

Note: [a] The discrepancy in ridership between the inbound and outbound 70A is due to the loop in Waltham and riders being counted as they ride around the loop.

[b] Ridership data for the 71 is from two different time periods; Weekday and Saturday ridership figures are from Spring 2013, Sunday ridership is from Fall 2014; all 71 ridership data is non-APC data.

Average combined daily boardings and alightings for each stop along the Arsenal Street Corridor, for both Routes 70 and 70A, are summarized in Table 2-10. The Arsenal Mall area sees over 1,300 combined boardings and alightings at its six bus stops each weekday, comprising over two thirds of all weekday boardings and alightings along the corridor.

Table 2-10 Arsenal Street Corridor Weekday Boardings and Alightings by Stop

Bus Stop Location	Direction of travel	Boardings	Alightings
Arsenal St at Watertown + Arsenal Mall	Outbound	190	217
500 Arsenal St - Watertown + Arsenal Mall	Inbound	220	153
Arsenal St opposite Elm St	Inbound	114	29
Arsenal St opposite Arlington St	Inbound	120	22
Arsenal St at Arlington St	Outbound	23	117
Arsenal St opposite School St	Inbound	98	39
Arsenal St at School St	Outbound	43	88
Arsenal St at Elm St	Outbound	19	109
Arsenal St opposite Arsenal Ct Dr	Outbound	27	72
Arsenal St at Arsenal Ct	Inbound	60	27
Arsenal St at Irving St	Inbound	57	19
Arsenal St at Irving St	Outbound	15	44
Arsenal St at Beachwood Ave	Inbound	33	5
Arsenal St at Louise St	Inbound	30	5
Arsenal St opposite Beachwood Ave	Outbound	6	29
Arsenal St opposite Louise St	Outbound	6	19
Arsenal St opposite VFW Post 1105	Outbound	6	12
Arsenal St at Beacon Pk	Inbound	9	3
Arsenal St opposite Beacon Pk	Outbound	2	7

Source: Fall 2014 Bus ridership data (Provided by MBTA). Results rounded to nearest whole number.
Note: Bus stops sorted by total combined boardings and alightings in descending order

Average weekday boardings and alightings by stop for bus routes travelling within or connecting to the Arsenal Street Corridor are illustrated in Figure 2-6. Located off of but proximate to the corridor, the Watertown Yard and Watertown Square stops are the two busiest stops in the Study Area vicinity with over 3,100 and 1,600 daily combined boardings and alightings, respectively.

Vehicle Loading

The MBTA's *Service Delivery Policy*[2] defines the levels of crowding that are acceptable by time period and mode of transportation. For MBTA bus service, the acceptable ratio of passengers to seats during Early AM, AM Peak, Midday School, and PM Peak periods is 140 percent. For all other periods, the acceptable ratio is 100 percent. For buses along the Arsenal Street Corridor which have a seated capacity of 39 passengers, the maximum acceptable load equals 54 passengers during the peak periods. According to the *Service Delivery Policy*, "For bus, on weekdays the loads

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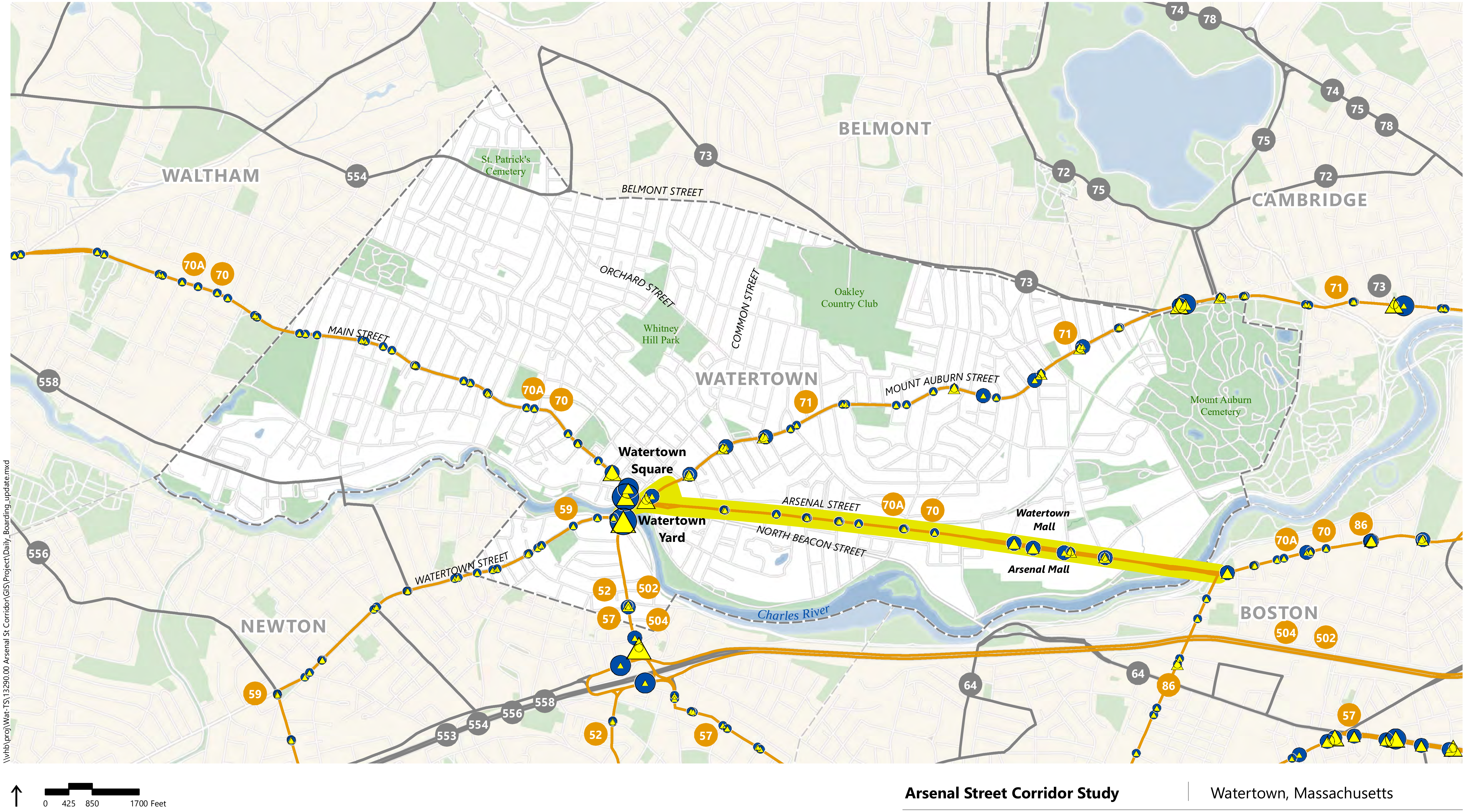
[2] MBTA. *Service Delivery Policy.* June 2, 2010.

Apr 03, 2017 | **FIGURE 2-6**



Alightings

▲	0 to 100
▲	101 to 250
▲	251 to 750
▲	Over 750

Boardings

●	0 to 100
●	101 to 250
●	251 to 750
●	Over 750

#	Study Area MBTA Bus Routes
#	Other MBTA Bus/Trackless Trolley Routes
▬	Arsenal Street Corridor

Arsenal Street Corridor Study | Watertown, Massachusetts

Daily Transit Ridership Map

Source: MassGIS, MBTA

\\vhb\proj\Wat-TS\13290.00 Arsenal St Corridor\GIS\Project\Daily_Boarding_update.mxd cannot exceed the standard when averaged over any 30-minute segment of an Early AM, AM Peak, Midday School or PM Peak period, or any 60-minute segment of a Midday Base, Evening, Late Evening, or Night/Sunrise period."[3]

For the vehicle loading analysis, only transit routes serving the length of the Arsenal Street Corridor were analyzed. The two routes that serve the length of the corridor are the 70 and the 70A, which each serve the 19 stops along the corridor. For this analysis, the ratio of passengers to seats was calculated based on existing weekday ridership data supplied by the MBTA from the Spring 2013 and Fall 2014 seasons, the most current data available at the time of the existing conditions analysis. The analysis consisted of averaging the peak loads during 30 or 60-minute segments (as appropriate). Subsequently, the maximum 30 or 60-minute segment loading for each period of the day was identified, as summarized in Table 2-11. These values represent maximum average loading values that occur on the entire line, not just over the Arsenal Street Corridor. High loads during the Night/Sunrise period are due to high ridership at the beginning of the morning commute, which is included as part of the nighttime ridership period as defined by MBTA convention.

Table 2-11 Route 70/70A Weekday Maximum Average Passenger Loads by Time Period

	Route 70		Route 70A	
Period	Inbound	Outbound	Inbound	Outbound
Early AM 6:00 a.m. – 6:59 a.m.	**55**	28	**58**	30
AM Peak 7:00 a.m. – 8:59 a.m.	47	52	45	45
Midday Base 9:00 a.m. – 1:29 p.m.	33	36	33	34
Midday School 1:30 p.m. – 3:59 p.m.	**57**	42	39	43
PM Peak 4:00 p.m. – 6:29 p.m.	42	50	50	44
Evening 6:30 p.m. – 9:59 p.m.	**40**	**48**	29	n/a
Late Evening 10:00 p.m. – 11:59 p.m.	28	33	n/a	n/a
Night/Sunrise 12:00 a.m. – 5:59 a.m.	**43**	21	n/a	23

Source: MBTA Provided Ridership Data, from SP13 and FA14

Note: Results rounded to the nearest whole number. Bold text indicates passenger loads exceed acceptable levels for the given time period, based on levels defined in the MBTA's *Service Delivery Policy*. For Early AM, AM Peak, Midday School, and PM Peak, the loads above represent the maximum 30 minute load, where the acceptable load is 54 passengers or less. For all other periods the loads above represent the maximum 60 minute load, where the acceptable load is 39 passengers or less.

Findings of the existing load conditions analysis for Routes 70 and 70A show that despite meeting acceptable service standards during most service periods, the existing passenger loads slightly exceed the MBTA's *Service Delivery Policy* standards during the early morning peak in the inbound direction, in the evening peak on the Route 70 in both directions, and in the midday and late night inbound runs on the Route 70.

▼

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[3] MBTA Service Delivery Policy - 2010 Update, Pg. 13

A similar analysis was performed for the Arsenal Street Corridor segment, based on the combined loads on the Routes 70 and 70A. Average loading for the peak 30-minutes along the Arsenal Street Corridor is shown in Figure 2-7 and Figure 2-8 for the morning and evening peaks, respectively. During the AM Peak, the highest inbound loads within the corridor average approximately 46 passengers as buses depart the stop opposite Arlington Street. The highest outbound loads on the corridor occur approaching Arlington Street, at an average of approximately 49 passengers. During the PM peak, the highest inbound loads on the corridor occur as buses depart the stop opposite Arlington Street, at an average of approximately 40 passengers. The highest outbound loads on the corridor occur between VFW Post 1105 and Louise Street, at an average of approximately 40 passengers. While the 70 and 70A do see heavy loading in each direction during peak periods, loading within the Arsenal Street Corridor itself is within acceptable levels as defined by the MBTA's *Service Delivery Policy*.

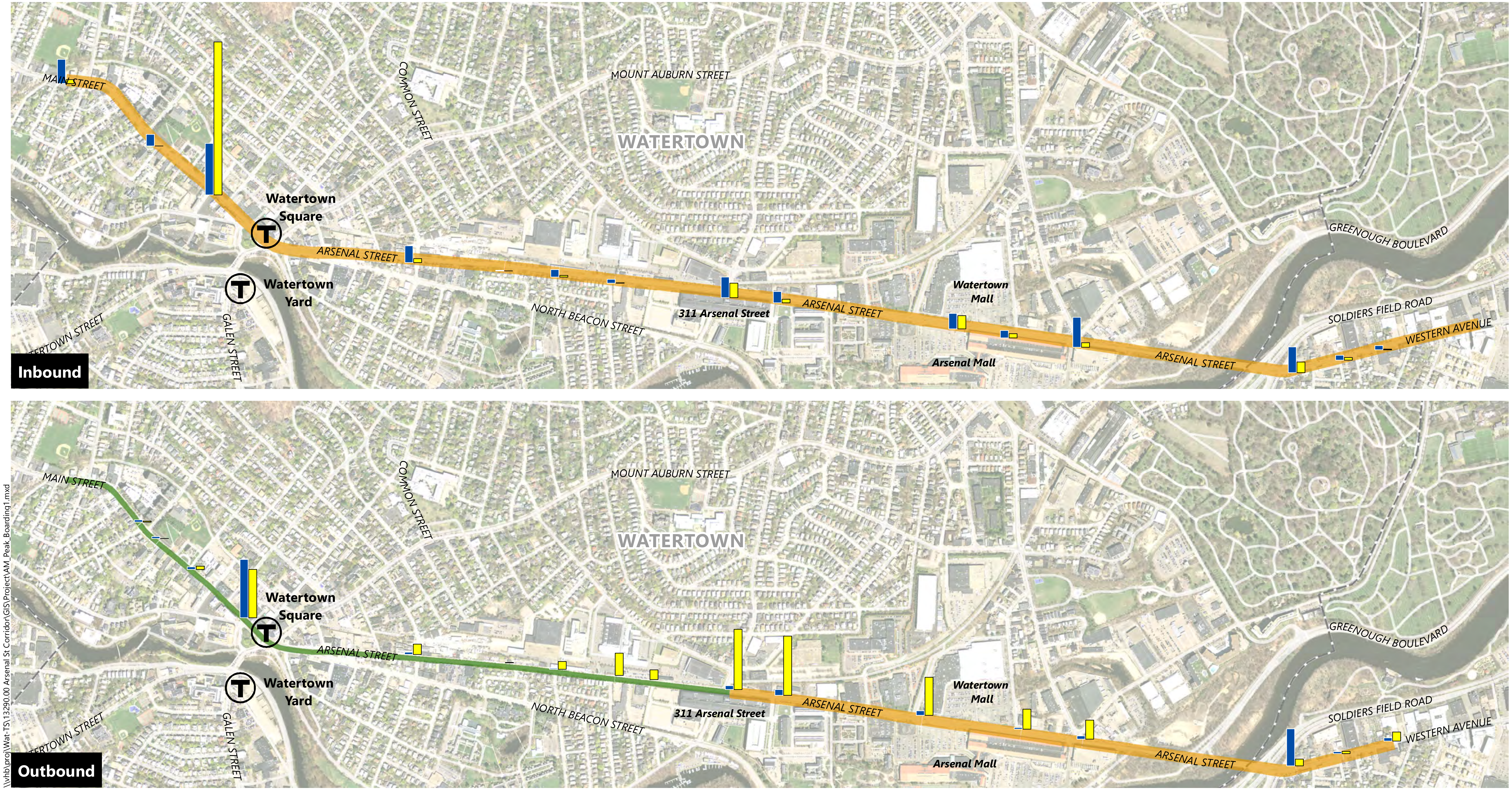
Service Reliability

On-time performance of existing transit services operating along the Arsenal Street Corridor was assessed using Running Time Report data from October 2015, provided by the MBTA. Average on-time performance percentages on the trip level, which consider departure lateness (and penalties for early departure) from the first stop of each trip, were calculated by time period using trip on-time performance data on Routes 70 and 70A. Findings of the trip level reliability analysis are summarized in Table 2-12. When averaged over the full day, on-time performance for bus trips on the corridor ranges from 47.3 percent to 77.8 percent.

Table 2-12 Route 70/70A Trip On-Time Performance Summary

	Route 70		Route 70A	
Period	**Inbound**	**Outbound**	**Inbound**	**Outbound**
Early AM	96.4%	87.5%	48.0%	81.9%
AM Peak	75.4%	77.0%	61.6%	60.5%
Midday Base	75.5%	79.2%	43.9%	88.1%
Midday School	68.9%	72.9%	63.2%	83.3%
PM Peak	54.5%	78.8%	36.8%	61.2%
Evening	55.2%	59.5%	25.1%	n/a
Late Evening	89.5%	94.5%	n/a	n/a
Night/Sunrise	85.5%	89.3%	n/a	76.5
Service Day Average	70.2%	77.8%	47.3%	73.6%

Source: MBTA Running Time Reports (Trip Level) for October 2015 (provided by MBTA)



\\vhb\proj\Wat-TS\13290.00 Arsenal St Corridor\GIS\Project\AM_Peak_Boarding1.mxd

0 250 500 1000 Feet

BY SEGMENT

Average Vehicle Load (Passengers)

🟩 0 to 39 (Seats Available)

🟧 40 to 54 (Some Standees)

🟥 Over 54 Passengers

BY STOP

Average Number of Boardings/Alightings

4

2

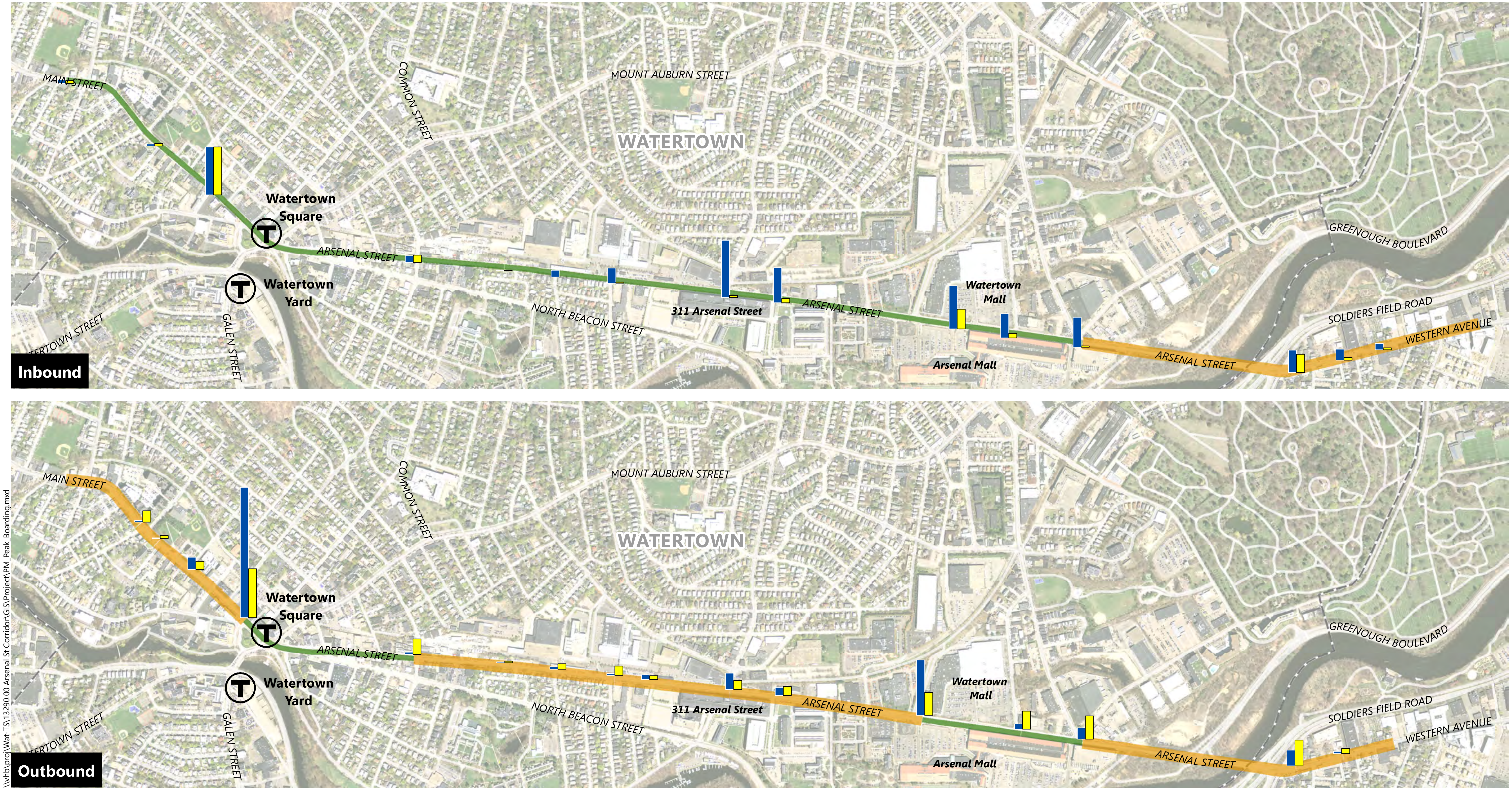
1

Boardings

Alightings

Arsenal Street Corridor Study | Watertown, Massachusetts

MBTA Routes 70/70A
AM Peak 30-Minute Vehicle Loads
Source: MassGIS, MBTA



\\vhb\proj\Wat-TS\13290.00 Arsenal St Corridor\GIS\Project\PM_Peak_Boarding.mxd

↑ 0 250 500 1000 Feet

BY SEGMENT

Average Vehicle Load (Passengers)

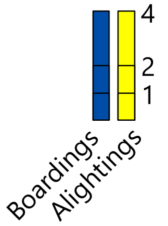
🟩 0 to 39 (Seats Available)

🟧 40 to 54 (Some Standees)

🟥 Over 54 Passengers

BY STOP

Average Number of Boardings/Alightings



Arsenal Street Corridor Study | Watertown, Massachusetts

MBTA Routes 70/70A
PM Peak 30-Minute Vehicle Loads

Source: MassGIS, MBTA

According to the MBTA's *Service Delivery Policy*[4], for any bus route to be in compliance with the Schedule Adherence Standard, 75 percent of all time points along a route over the entire service day must be on time. Average on time performance percentages on the timepoint level, which consider departure lateness (and penalties for early departure) for all trip timepoints, were calculated by time period using timepoint on-time performance data on Route 70 and 70A. Findings for the timepoint reliability analysis are summarized in Table 2-13. When averaged over the full day, neither the Route 70 or Route 70A meet the Schedule Adherence Standard of 75 percent.

Table 2-13 Route 70/70A Timepoint On-Time Performance Summary

	Route 70		Route 70A	
Period	**Inbound**	**Outbound**	**Inbound**	**Outbound**
Early AM	80.5%	69.7%	61.8%	72.7%
AM Peak	58.2%	56.1%	31.3%	59.6%
Midday Base	66.6%	68.4%	46.1%	79.6%
Midday School	49.1%	63.4%	57.1%	63.5%
PM Peak	42.1%	53.0%	25.0%	38.3%
Evening	57.4%	59.5%	25.4%	n/a
Late Evening	81.0%	89.8%	n/a	n/a
Night/Sunrise	80.1%	90.8%	n/a	73.8%
Service Day Average	60.6%	66.2%	39.4%	61.7%

Source: MBTA Timepoint On-Time Reports for October 2015 (provided by MBTA)

Vehicular Traffic Evaluation

The following section provides a description and assessment of the existing transportation conditions of the study area. This includes traffic volumes, operations, safety, pedestrian and bicycle concerns.

Existing Infrastructure Review

Arsenal Street, the major route of travel in this corridor study, is an urban minor arterial roadway that provides an east-west connection between Soldiers Field Road/ Birmingham Parkway to the east and Main Street/Galen Street/ Mount Auburn Street/North Beacon Street (Watertown Square) to the west. West of Watertown Square, Arsenal Street continues as Main Street, and extends to the Watertown/

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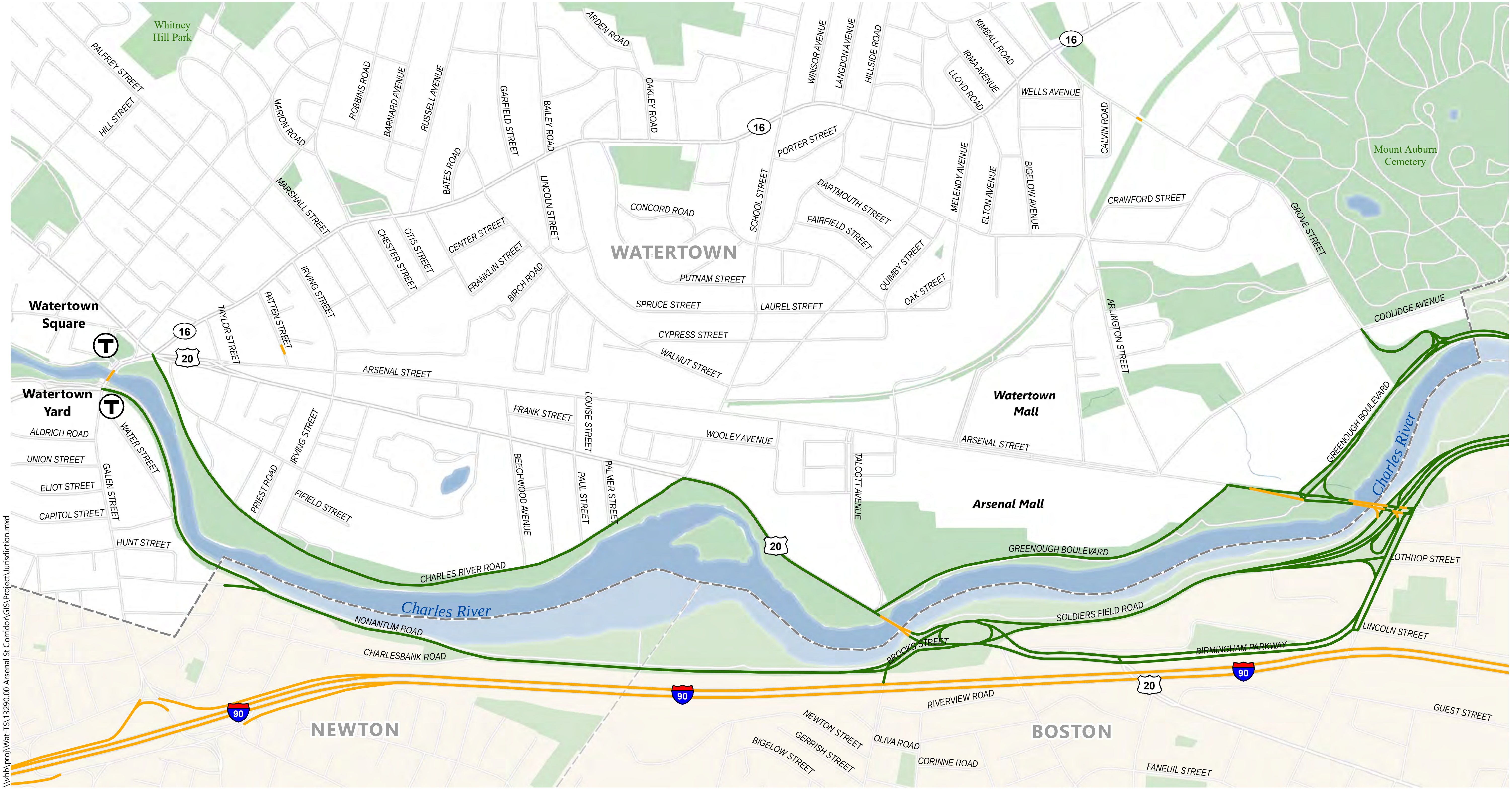
[4] MBTA Service Delivery Policy - 2010 Update, Pg. 10

Waltham town line. Arsenal Street, west of Louise Street, generally consists of one lane in each direction. East of Louise Street, two lanes are provided in each direction throughout the remainder of the corridor.

Within the study area, Arsenal Street is under local jurisdiction between Watertown Square and Greenough Boulevard (south). East of Greenough Boulevard (south), Arsenal Street is under the jurisdiction of the Massachusetts Department of Conservation and Recreation (DCR), with the exception of the bridge over the Charles River, which is owned by MassDOT. An illustration of the roadway jurisdiction within the study area is shown in Figure 2-9.



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↑ 0 200 400 800 Feet

Ⓢ Signalized Study Intersection
Ⓤ Unsignalized Study Intersection

Roadway Jurisdiction

🟧	MassDOT
🟩	DCR
⬜	City or Town Road

Arsenal Street Corridor Study | Watertown, Massachusetts

Roadway Jurisdiction Map

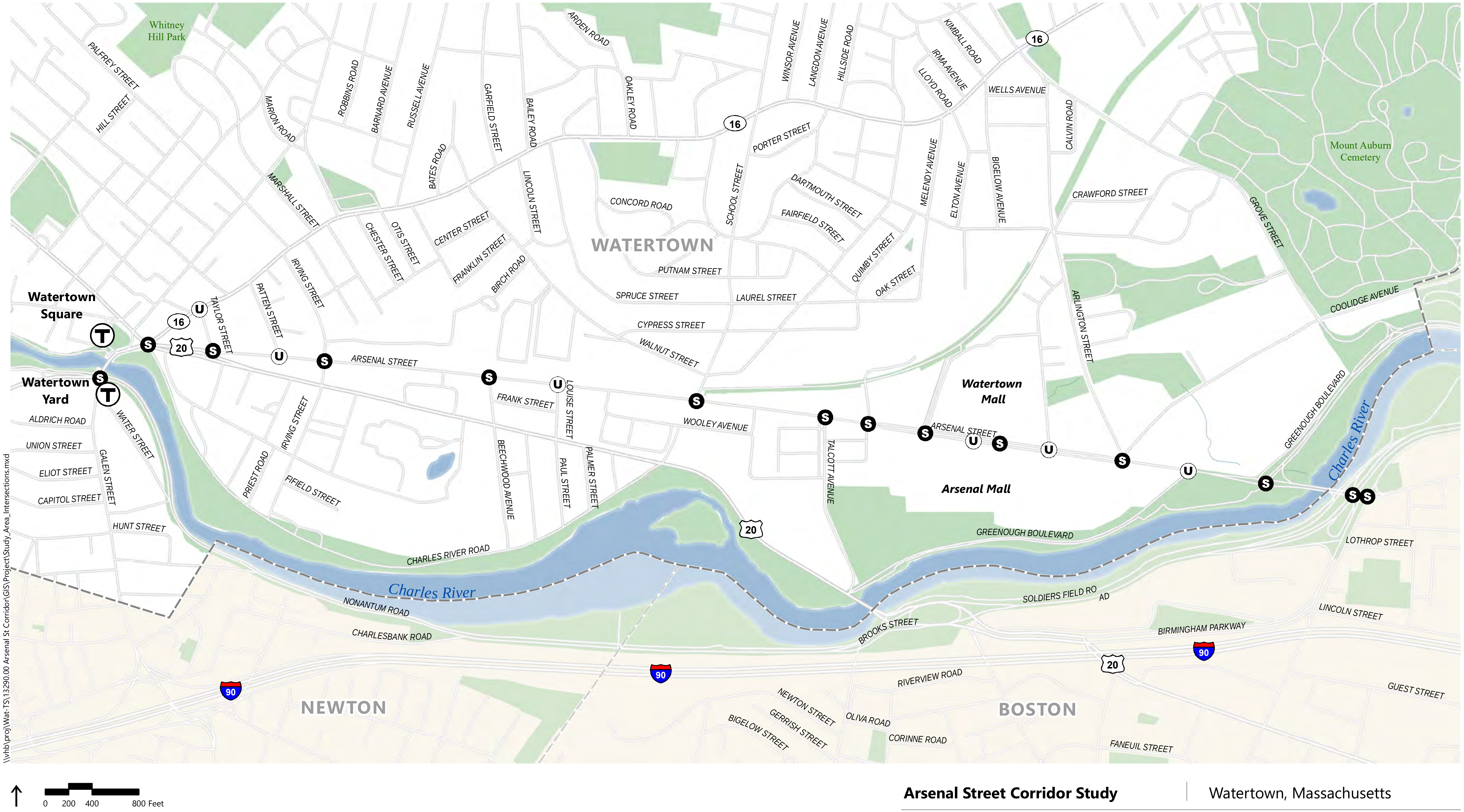
Source: MassGIS

Study Area Intersections

The focus of the study primarily spans along Arsenal Street/Western Avenue, between Birmingham Parkway in the east and Watertown Square in the west. Depicted in Figure 2-10, the study area intersections include the following:

- Watertown Street/Nonantum Road at Galen Street (signalized)
- Mt Auburn Street at Main Street, Arsenal Street, and Charles River Road (signalized)
- North Beacon Street/Arsenal Street/Taylor Street (signalized)
- Mt Auburn Street at Taylor Street (unsignalized)
- Arsenal Street at Patten Street (unsignalized)
- Arsenal Street at Irving Street (signalized)
- Arsenal Street at Beechwood Avenue (signalized)
- Arsenal Street at Louise Street (unsignalized)
- Arsenal Street at School Street (signalized)
- Arsenal Street at Talcott Avenue/Roma Tile driveway (signalized)
- Arsenal Street at Birch Street/Arsenal Court (signalized)
- Arsenal Street at Arsenal Mall/ Watertown Mall Rear Entrance (signalized)
- Arsenal Street at Arsenal Mall (unsignalized)
- Arsenal Street at Watertown Mall (signalized)
- Arsenal Street at Elm Street (unsignalized)
- Arsenal Street at Arlington Street/Coolidge Avenue/Home Depot Driveway (signalized)
- Arsenal Street at Greenough Boulevard (south) (unsignalized)
- Arsenal Street at Greenough Boulevard (north) (signalized)
- Arsenal Street at Soldiers Field Road (signalized)
- Arsenal Street at Birmingham Parkway (signalized)

Apr 03, 2017 | **FIGURE 2-10**



Ⓢ Signalized Study Intersection

Ⓤ Unsignalized Study Intersection

Arsenal Street Corridor Study | Watertown, Massachusetts

Study Area Intersections Map

Source: MassGIS

Signal Inventory

The traffic signal and controller equipment at the 14 signalized intersections within the study area were reviewed. Issues were noted at all locations and include:

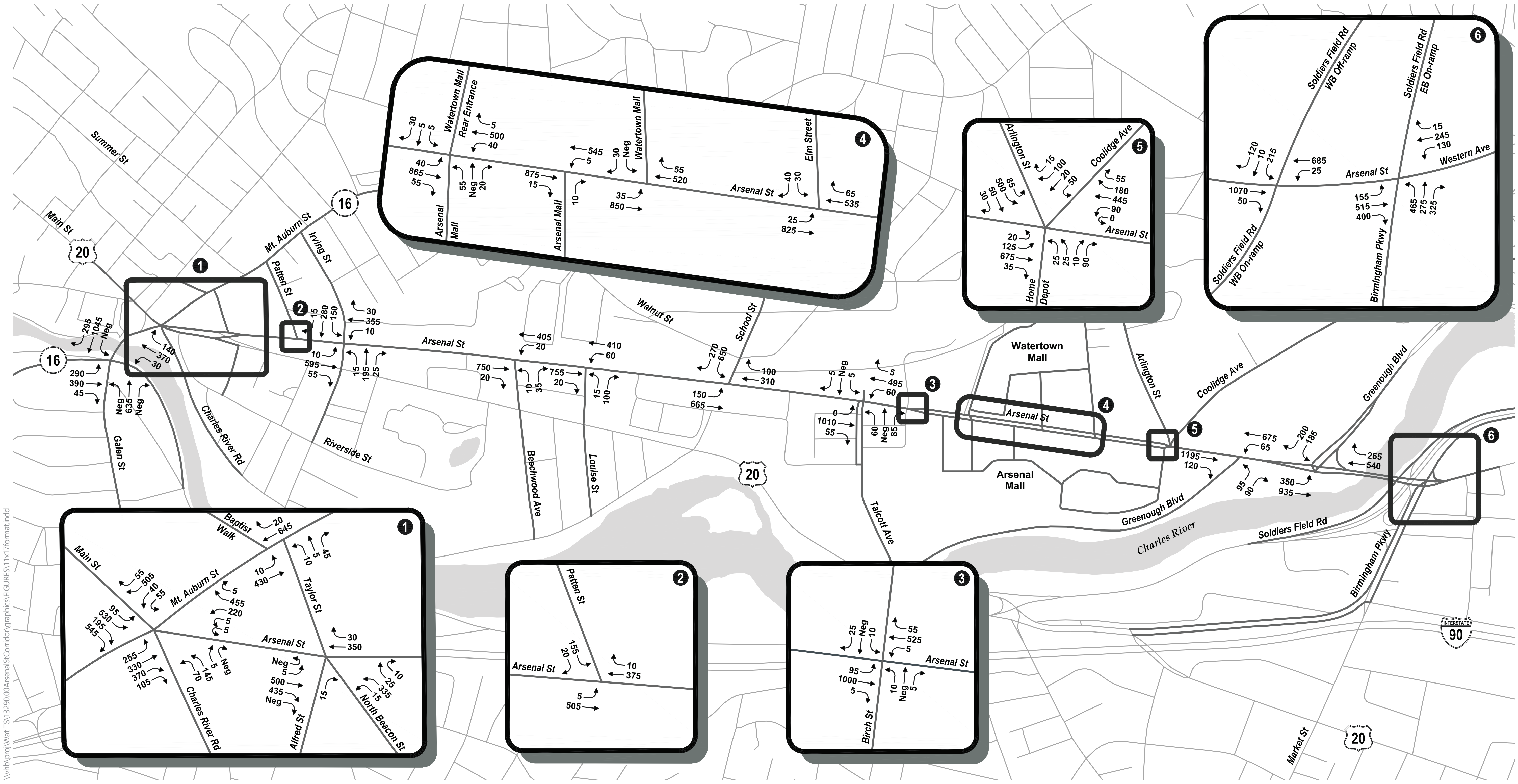
- **Manual on Uniform Traffic Control Devices (MUTCD) Compliance** – Non-conforming pedestrian signal head type, push button placement, pedestrian signal operations, etc.
- **Americans with Disabilities Act (ADA) Compliance** – Push button type, lack of pedestrian accommodations, etc.
- **Operational/Maintenance Issues** – Vehicle recall, detection, controller clock off (time of day, daylight savings), coordination issues, etc.
- **Safety Deficiencies** – Pedestrian signal phasing, pedestrian-vehicle and vehicle-vehicle conflicts.

A complete signal inventory summary by location is included in the Appendix. Deficiencies noted during the inventories were reviewed and short- and long-term solutions (as applicable) were identified as part of the Alternatives Development process (Chapter 4).

Traffic Demands

To identify current flow characteristics along the Arsenal Street corridor, automatic traffic recorder (ATR) data were obtained for a typical weekday to quantify hourly fluctuations. Table 2-14 summarizes the traffic volumes at various locations along Arsenal Street. In addition, turning movement counts (TMCs) were collected at key intersections to quantify peak hour vehicular, pedestrian, and bicycle demands. Weekday morning and evening peak hour turning movement are illustrated in Figures 2-11 and Figure 2-12 respectively. Traffic volume data are included in the Appendix.

Arsenal Street carries between 14,500 and 23,500 vehicles per day (vpd). West of School Street, traffic patterns reflect a typical commuting pattern, with the majority of traffic traveling eastbound during the morning and westbound during the evening. Traffic increases towards the eastern section of Arsenal Street, which could be attributed to the major employers located along the corridor and the use of Soldier's Field Road, Greenough Boulevard, and Western Avenue to regionally access these employment centers.



Not to scale

Arsenal Street Corridor Study | Watertown, Massachusetts

2015 Existing Condition
Weekday Morning Peak Hour
Traffic Volume

Source: MassGIS
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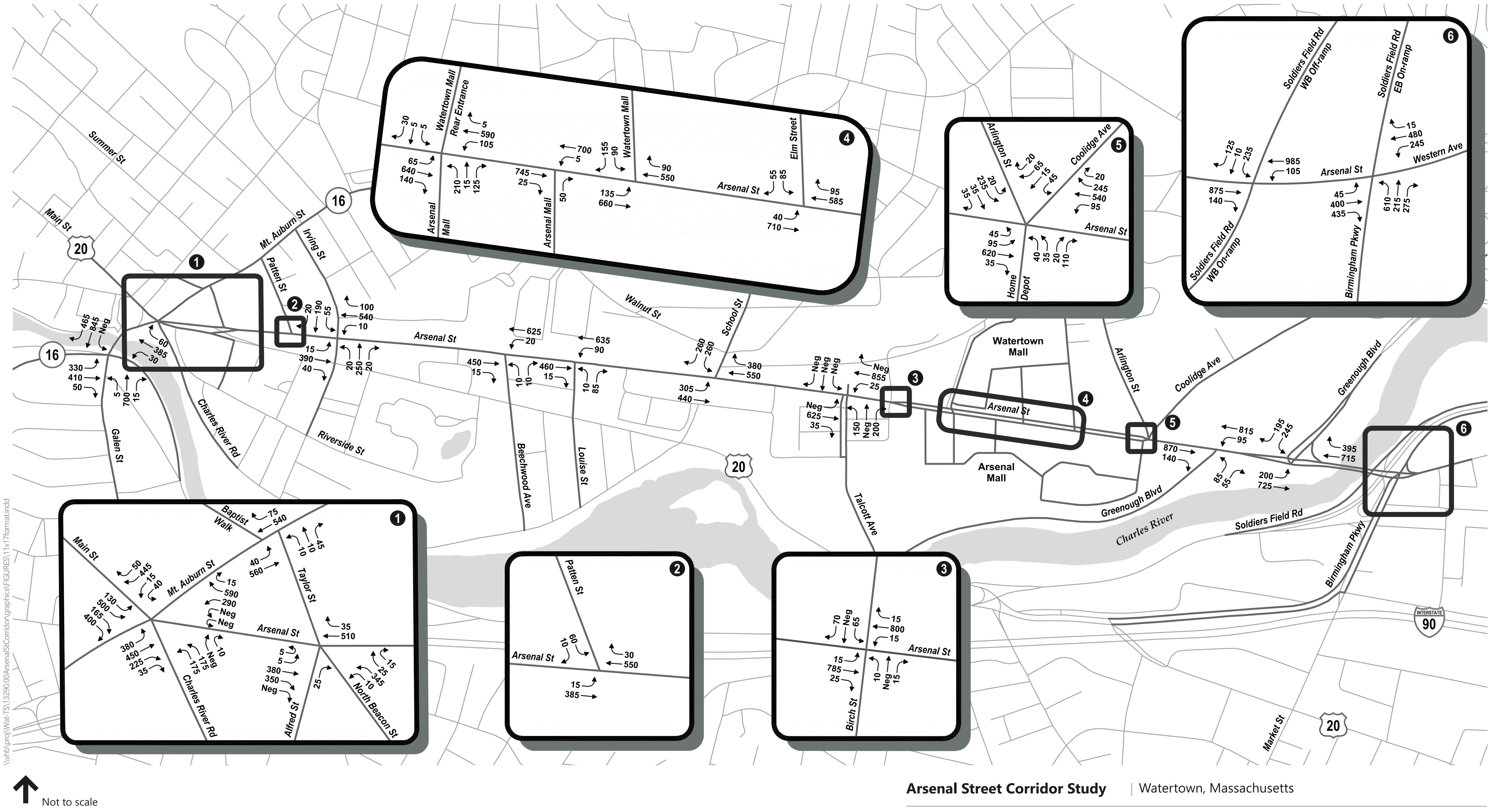

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Arsenal Street Corridor Study | Watertown, Massachusetts

2015 Existing Condition Weekday Evening Peak Hour Traffic Volume

Source: MassGIS

Table 2-14 ATR Summary

	Daily [a]	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
Location	Weekday	Volume [b]	K Factor [c]	Dir. Dist. [d]	Volume	K Factor	Dir. Dist.
Arsenal Street, Between Patten Street and Taylor Street	14,515	885	6.1%	57% EB	1,035	7.1%	57% WB
Arsenal Street, Between Wooley Ave and School Street	19,685	1,345	6.8%	56% EB	1,535	7.8%	53% WB
Arsenal Street, Between Arsenal Mall Driveways	17,430	1,260	7.2%	56% EB	1,395	8.0%	50% EB
Arsenal Street, Between Greenough Boulevard (north) and Greenough Boulevard (south)	23,500	2,035	8.7%	64% EB	1,820	7.7%	53% EB

Source: MassDOT. Based on automatic traffic recorder (ATR) counts conducted in September 2015.
a - Average daily traffic (ADT) volume expressed in vehicles per day
b - Peak period traffic volumes expressed in vehicles per hour
c - Percent of daily traffic that occurs during the peak hour
d - Directional distribution of peak period traffic

Traffic Operations

To understand the existing traffic operations and assess the quality of flow at the study area intersections, traffic analysis was conducted using VISSIM software.

VISSIM is a transportation planning and operations software package that is designed to provide a sophisticated visual and analytical representation of traffic operations on a full range of functionally classified roadways. A microscopic simulation software, where each vehicle is simulated individually, VISSIM can simulate complicated driving behavior on roadway facilities as well as interaction between all modes. Users can also program realistic lane geometries, various vehicle types, public transit, and designate different vehicle routes within the model.

Simulation Methodology

The VISSIM model development primarily consists of three stages: data compilation/ network coding, model calibration/ validation, and model application. The following describes each stage as applied to the VISSIM model for this Project.

Data Compilation/ Network Coding

The initial step in creating a VISSIM network involves compiling all essential background data for the model, which typically includes lane geometries and widths of study area roadways, pedestrian crosswalk locations, signal timing plans, and roadway speeds. Based on these collected data, a base roadway network of the study area was then created. As VISSIM allows for extreme precise route assignments for vehicles within the simulation area, that capability was applied in the Project's model by inputting volumes to individual approaches and basing routing decisions on peak hour traffic volumes collected in the study area, defining the percentage of traffic entering and exiting each roadway link.

Model Calibration/ Validation

Separate simulation models for the morning and evening peak hours were created at the end of the data compilation and network coding stage. These two models were then calibrated to ensure accurate model operations. In this stage, the models were calibrated based on characteristics such as turning movement counts and queues at the intersections.

Multiple runs of each of the VISSIM models were conducted to introduce variation to vehicle loadings and the nature of vehicle arrivals in the simulation. Calibration of the VISSIM model for each of the peak hour was conducted to accurately and realistically model operations as they were observed in the field. Traffic volume data was collected from each model and compared to the existing peak hour traffic volumes.

All model runs were conducted using a 30-minute seeding period, followed by a 60-minute simulation period and a 30-minute “cool-down” period. Evaluation of the results included in this report are based on operations of the roadway facilities within the 60-minute simulation period only.

Model Application

Future condition scenarios will be based on the calibrated existing models, and will include proposed roadway improvements and future traffic volume projections.

Simulation Results

The evaluation criteria used to analyze the roadway segments in this simulation evaluation were based on the measures of effectiveness (MOEs) provided by the VISSIM model. The VISSIM output includes a variety of MOEs, which are used to evaluate the operational qualities of a roadway segment or an entire network. For this project, three critical measures of effectiveness (MOE) from the VISSIM data output include: average vehicle delay, average queue lengths, and maximum queue lengths.

The term 'level of service' (LOS) is used to denote the different operating conditions that occur on a given roadway segment under various traffic volume loads, and provides an index to the operational qualities of a roadway segment or an intersection. According to the Highway Capacity Manual (HCM)[5], LOS designations for intersections are based on vehicle delays. Ranging from A to F, LOS A represents the least congested operating conditions and LOS F represents the most congested conditions. Typically, LOS D (as defined in the HCM) is considered to be the acceptable limit and LOS E or LOS F conditions are typically considered unacceptable. LOS criteria are defined differently for signalized and unsignalized intersections. As VISSIM only provides the average vehicle delays and does not specifically report levels-of-service, HCM level-of-service designations were applied to VISSIM delay results.

Signalized Intersections

Morning and evening peak hour VISSIM results for the signalized intersections in the study area are presented in Table 2-15 and Table 2-16 respectively and illustrated in Figure 2-13. The tables summarize the delay, level of service, average queues and maximum queues for each lane group, as well as the intersection as a whole.

The following intersections operate at LOS E or LOS F during the morning and/or evening peak hours:

- Galen Street at Watertown Street/ Nonantum Road (Weekday morning)
    - Eastbound left-turns on Watertown Street operate at LOS E while westbound Nonantum Road and northbound Galen Street operates at LOS F. The deficiencies for these approaches are mostly likely related to the northbound Galen Street queue that extends from the downstream intersection (Arsenal Street/ Main Street at Galen Street/ North Beacon Street/Charles River Road/Mount Auburn Street).
- Arsenal Street/ Main Street at Galen Street/ North Beacon Street/Charles River Road/Mount Auburn Street (Weekday morning and evening)
    - During the morning peak hour, eastbound Main Street operates at LOS F, and average queues for this approach extends past the Watertown Fire Department.
    - Westbound Arsenal Street left-turns operate at LOS E during both morning and evening peak hours.
    - Northbound through/right-turn lanes along Galen Street operate at LOS F and LOS E during the morning and evening peak hour respectively. The average queues for this lane group extends past the next intersection (Galen Street at Nonantum Road/ Watertown Street).

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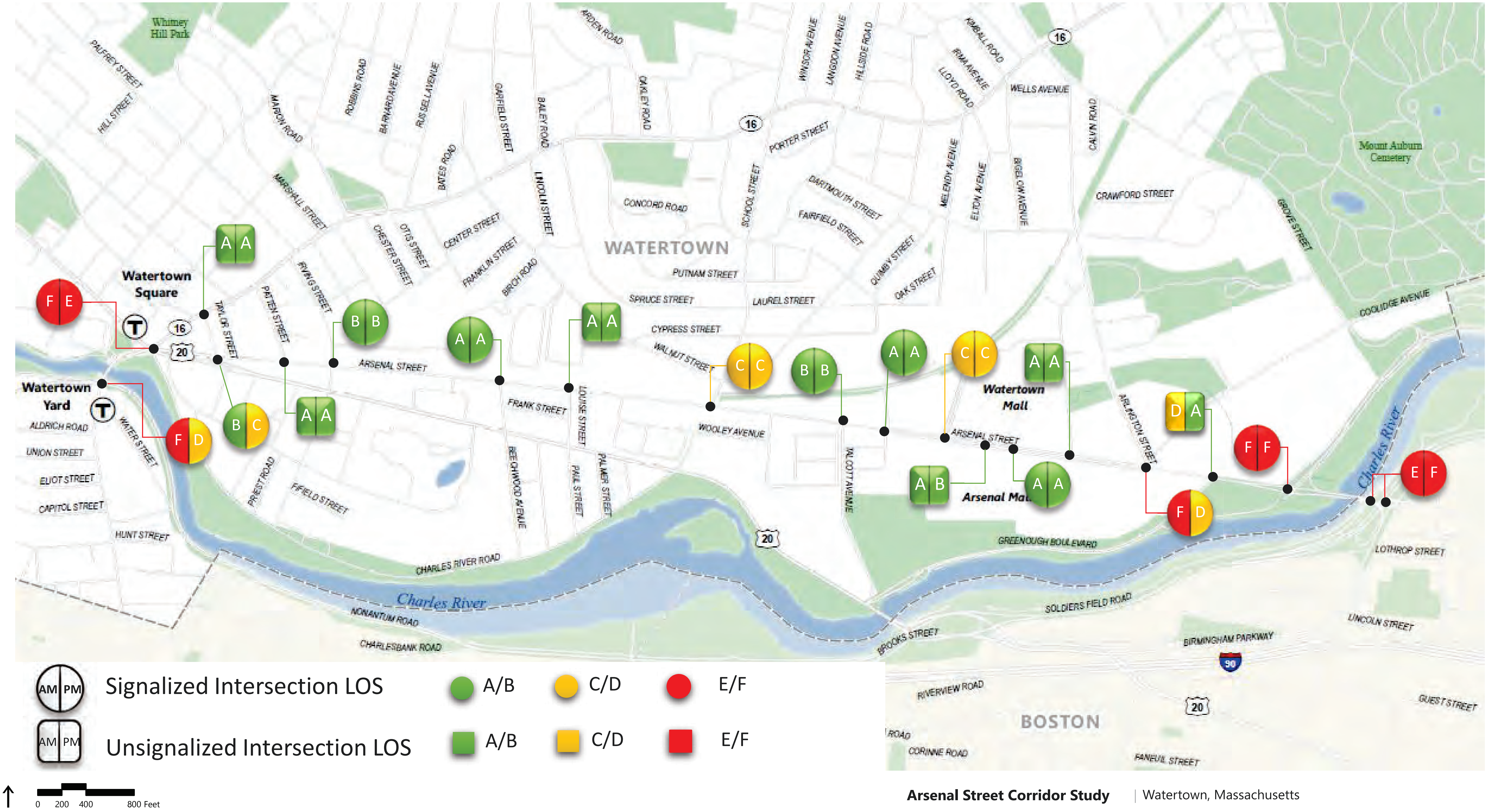
[5] Highway Capacity Manual; Transportation Research Board; 2010.

    - Southbound Mount Auburn Street left-turns operate at LOS E during the morning peak hour, while through/right-turn lanes operate at LOS F and LOS E during the respective morning and evening peak hours.
    - The deficiencies at Watertown Square intersection can be attributed to high vehicle demands on all approaches to the intersection, the proximity of major signalized intersections on each end of the bridge over the Charles River, and complex traffic signal phasing.
- Arsenal Street at Arlington Street/Coolidge Avenue/Home Depot Driveway (Weekday morning)
    - With the exception of westbound Arsenal Street and the northbound left-turn/through lanes, all lane groups operate at either LOS E or LOS F. The five-legged geometry and difficulty making some conflicting turning movements at this location contribute to the poor levels of service.
- Arsenal Street at Greenough Boulevard (north) (Weekday morning and evening)
    - Eastbound left-turn lane operates at LOS E during the morning peak hour, while through lanes operate at LOS F during both morning and evening peak hours. Similarly, southbound left-turn lanes also operate at LOS E during both morning and evening peak hours. These deficiencies are mostly likely related to the eastbound Arsenal Street queue that extends from the next intersection (Arsenal Street/Western Avenue at Soldiers Field Road On-Off Ramps/ Birmingham Parkway).
- Arsenal Street/Western Avenue at Soldiers Field Road On-Off Ramps/ Birmingham Parkway (Weekday morning and evening)
    - With the exception of northbound Birmingham Parkway, all of the approaches operate at either LOS E or LOS F during both morning and evening peak hours. The average queue along eastbound Arsenal Street extends to the next intersection (Arsenal Street at Greenough Boulevard (north)) during both peak hours. As noted above, these deficiencies are most likely related to the proximity of the adjacent traffic signal, as well as the inability to modify geometry on the bridge deck.



Signalized Intersection LOS ● A/B ● C/D ● E/F

Unsignalized Intersection LOS 🟩 A/B 🟨 C/D 🟥 E/F

Arsenal Street Corridor Study | Watertown, Massachusetts

Existing Traffic Operation Results

Source: MassGIS

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Table 2-15 Signalized Intersection Capacity Analysis Summary (Morning Peak Hour)

Movement		Veh. Delay[1]	LOS[2]	Avg. Q[3]	Max. Q[4]
Galen Street at Watertown Street/Nonantum Road					
Watertown Street	EB LT	58	E	75	267
Watertown Street	EB TH/RT	31	C	75	267
Nonantum Road	WB LT-TH/TH-RT	106	F	152	367
Galen Street	NB LT/TH-TH/RT	211	F	347	864
Galen Street	SB LT/TH-TH	41	D	146	405
Galen Street	SB RT	16	B	18	210
	Overall	**82**	**F**		
Arsenal Street/Main Street at Galen Street/North Beacon Street/Charles River Road/ Mount Auburn Street					
Main Street	EB LT	126	F	29	149
Main Street	EB TH-TH/RT	137	F	895	1,486
Main Street	EB RT	127	F	919	1,507
Arsenal Street	WB LT	66	E	85	503
Arsenal Street	WB TH/RT	44	D	62	217
Charles River Road	NWB LT/TH/RT	54	D	61	293
Galen Street	NB LT-LT	40	D	33	236
Galen Street	NB TH-TH/RT	102	F	426	542
Mount Auburn Street	SB LT	63	E	29	149
Mount Auburn Street	SB TH-TH/RT	93	F	203	398
	Overall	**95**	**F**		
Arsenal Street at North Beacon Street					
Arsenal Street	EB LT/TH-TH	8	A	15	171
Arsenal Street	WB TH-TH/RT	10	A	8	112
North Beacon Street	NWB LT/TH-TH	21	C	17	105
North Beacon Street	NWB RT	8	A	0	27
	Overall	**13**	**B**		
Arsenal Street at Irving Street					
Arsenal Street	EB LT/TH/RT	9	A	13	114
Arsenal Street	WB LT/TH/RT	8	A	8	83
Irving Street	NB LT/TH/RT	18	B	19	172
Irving Street	SB LT/TH/RT	29	C	87	543
	Overall	**16**	**B**		
Arsenal Street at Beechwood Avenue					
Arsenal Street	EB TH/RT	2	A	2	84
Arsenal Street	WB LT/TH	4	A	3	110
Beechwood Avenue	NB LT/RT	20	B	3	66
	Overall	**3**	**A**		

Table 2-15 Signalized Intersection Capacity Analysis Summary (Morning Peak Hour) cont.

Movement		Veh. Delay[1]	LOS[2]	Avg. Q[3]	Max. Q[4]
Arsenal Street at School Street					
Arsenal Street	EB LT	18	B	22	234
Arsenal Street	EB TH	13	B	22	234
Arsenal Street	WB TH-TH/RT	23	C	26	146
School Street	SB LT	25	C	80	363
School Street	SB LT/RT	28	C	80	363
	Overall	**21**	**C**		
Arsenal Street at Talcott Street/ Roma Tile Driveway					
Arsenal Street	EB LT/TH-TH/RT	17	B	34	198
Talcott Street	NB LT/TH	14	B	3	65
Arsenal Street	WB LT/TH-TH/RT	11	B	16	178
Talcott Street	NB RT	12	B	4	84
Roma Tile Driveway	SB LT/TH/RT	0	A	0	0
	Overall	**15**	**B**		
Arsenal Street at Birch Street/ Arsenal Court					
Arsenal Street	EB LT/TH-TH/RT	3	A	5	152
Arsenal Street	WB LT/TH-TH/RT	6	A	6	137
Arsenal Court	NB LT/TH/RT	49	D	3	21
Birch Street	SB LT	38	D	2	42
Birch Street	SB TH/RT	34	C	3	41
	Overall	**5**	**A**		
Arsenal Street at Arsenal Mall/ Watertown Mall (rear) Entrance					
Arsenal Street	EB LT	30	C	5	64
Arsenal Street	EB TH-TH	13	B	25	178
Arsenal Street	EB RT	12	B	3	61
Arsenal Street	WB LT	36	D	7	92
Arsenal Street	WB TH-TH/RT	29	C	101	273
Arsenal Mall Driveway	NB LT/TH	31	C	9	88
Arsenal Mall Driveway	NB RT	19	B	1	68
Watertown Mall (Rear Entrance)	SB LT/TH/RT	21	C	3	88
	Overall	**20**	**C**		
Arsenal Street at Arsenal Mall/ Watertown Mall					
Arsenal Street	EB LT	8	A	0	0
Arsenal Street	EB TH-TH	1	A	1	131
Arsenal Street	WB TH-TH	6	A	5	111
Arsenal Street	WB RT	4	A	1	45
Watertown Mall Driveway	SB LT	0	A	1	42
Watertown Mall Driveway	SB RT	17	B	1	42
	Overall	**3**	**A**		

Table 2-15 Signalized Intersection Capacity Analysis Summary (Morning Peak Hour) cont.

Movement		Veh. Delay[1]	LOS[2]	Avg. Q[3]	Max. Q[4]
Arsenal Street at Arlington Street/ Coolidge Ave/ Home Depot Driveway					
Arsenal Street	EB LT	63	E	51	327
Arsenal Street	EB TH-TH/RT	91	F	83	329
Arsenal Street	WB LT	54	D	25	135
Arsenal Street	WB TH-TH/RT	39	D	72	281
Home Depot Driveway	NB LT/TH	27	C	21	127
Home Depot Driveway	NB RT	86	F	21	127
Coolidge Avenue	SWB LT/TH-TH/RT	56	E	31	157
Arlington Street	SEB LT/TH-TH/RT	155	F	842	1,658
	Overall	**86**	**F**		
Arsenal Street at Greenough Boulevard (North)					
Arsenal Street	EB LT	98	F	686	810
Arsenal Street	EB TH-TH	312	F	749	814
Arsenal Street	WB TH-TH	33	C	36	191
Arsenal Street	WB RT	1	A	0	0
Greenough Boulevard	SB LT-LT/RT	133	F	23	120
Greenough Boulevard	SB RT	39	D	31	256
	Overall	**>120**	**F**		
Arsenal Street/Western Avenue at Soldiers Field Road/ Birmingham Parkway					
Arsenal Street	EB LT/TH-TH/RT	62	E	587	744
Western Avenue	WB LT/TH-TH/RT	80	F	142	462
Birmingham Parkway	NB LT-LT	46	D	68	295
Birmingham Parkway	NB TH	51	D	84	341
Birmingham Parkway	NB RT	56	E	111	379
Soldiers Field Road WB Off-Ramp	SB LT/TH	70	E	51	280
Soldiers Field Road WB Off-Ramp	SB TH/RT	58	E	24	216
	Overall	**61**	**E**		

Source: VHB, Inc. using VISSIM Software
1 – Average Delay, in seconds per vehicle
2 – Level of Service
3 – Average queue length estimate, in feet
4 – Maximum queue length estimate, in feet
EB = Eastbound, WB = Westbound; NB = Northbound; SB = Southbound; NWB= Northwestbound; SEB = Southeastbound; SWB = Southwestbound
LT = Left-turn; TH = Through; RT = Right-turn

Table 2-16 Signalized Intersection Capacity Analysis Summary (Evening Peak Hour)

Movement		Veh. Delay[1]	LOS[2]	Avg. Q[3]	Max. Q[4]
Galen Street at Watertown Street/ Nonantum Road					
Watertown Street	EB LT	47	D	84	322
Watertown Street	EB TH/RT	36	D	84	322
Nonantum Road	WB LT-TH/TH-RT	65	E	72	254
Galen Street	NB LT/TH-TH/RT	27	C	55	349
Galen Street	SB LT/TH-TH	34	C	98	424
Galen Street	SB RT	17	B	41	400
	Overall	**36**	**D**		
Arsenal Street/Main Street at North Beacon Street/Charles River Road/ Mount Auburn Street					
Main Street	EB LT	51	D	33	215
Main Street	EB TH-TH/RT	53	D	90	408
Main Street	EB RT	28	C	58	429
Arsenal Street	WB LT	68	E	140	532
Arsenal Street	WB TH/RT	44	D	80	304
Galen Street	NB LT-LT	55	D	67	390
Galen Street	NB TH-TH/RT	55	E	148	492
Charles River Road	NWB LT/TH/RT	131	F	380	482
Mount Auburn Street	SB LT	46	D	12	84
Mount Auburn Street	SB TH-TH/RT	66	E	134	344
	Overall	**59**	**E**		
Arsenal Street at North Beacon Street					
Arsenal Street	EB LT/TH-TH	12	B	20	433
Arsenal Street	WB TH-TH/RT	12	B	14	142
North Beacon Street	NWB LT/TH-TH	43	D	69	848
North Beacon Street	NWB RT	9	A	0	28
	Overall	**22**	**C**		
Arsenal Street at Irving Street					
Arsenal Street	EB LT/TH/RT	10	B	12	137
Arsenal Street	WB LT/TH/RT	10	B	17	245
Irving Street	NB LT/TH/RT	16	B	22	170
Irving Street	SB LT/TH/RT	19	B	22	190
	Overall	**13**	**B**		
Arsenal Street at Beechwood Avenue					
Arsenal Street	EB TH/RT	1	A	0	36
Arsenal Street	WB LT/TH	2	A	3	131
Beechwood Avenue	NB LT/RT	18	B	1	22
	Overall	**2**	**A**		

Table 2-16 Signalized Intersection Capacity Analysis Summary (Evening Peak Hour) cont.

Movement		Veh. Delay[1]	LOS[2]	Avg. Q[3]	Max. Q[4]
Arsenal Street at School Street					
Arsenal Street	EB LT	19	B	25	175
Arsenal Street	EB TH	14	B	25	175
Arsenal Street	WB TH-TH/RT	25	C	54	246
School Street	SB LT	20	C	39	192
School Street	SB LT/RT	23	C	39	192
	Overall	**21**	**C**		
Arsenal Street at Talcott Street/ Roma Tile Driveway					
Arsenal Street	EB LT/TH-TH/RT	17	B	24	152
Arsenal Street	WB LT/TH-TH/RT	11	B	22	227
Talcott Street	NB LT/TH	13	B	8	83
Talcott Street	NB RT	13	B	9	105
Roma Tile Driveway	SB LT/TH/RT	0	A	0	0
	Overall	**13**	**B**		
Arsenal Street at Birch Street/ Arsenal Court					
Arsenal Street	EB LT/TH-TH/RT	3	A	5	164
Arsenal Street	WB LT/TH-TH/RT	7	A	12	229
Arsenal Court	NB LT/TH/RT	39	D	5	44
Birch Street	SB LT	41	D	11	67
Birch Street	SB TH/RT	41	D	13	84
	Overall	**8**	**A**		
Arsenal Street at Arsenal Mall/ Watertown Mall (rear) Entrance					
Arsenal Street	EB LT	36	D	9	85
Arsenal Street	EB TH-TH	15	B	22	196
Arsenal Street	EB RT	15	B	9	199
Arsenal Street	WB LT	40	D	21	159
Arsenal Street	WB TH-TH/RT	32	C	111	291
Arsenal Mall Driveway	NB LT/TH	33	C	40	236
Arsenal Mall Driveway	NB RT	27	C	14	124
Watertown Mall (Rear Entrance)	SB LT/TH/RT	30	C	5	60
	Overall	**25**	**C**		
Arsenal Street at Arsenal Mall/ Watertown Mall					
Arsenal Street	EB LT	17	B	0	43
Arsenal Street	EB TH-TH	5	A	7	196
Arsenal Street	WB TH-TH	10	A	9	130
Arsenal Street	WB RT	6	A	2	84
Watertown Mall Driveway	SB LT	16	B	14	156
Watertown Mall Driveway	SB RT	20	B	14	156
	Overall	**10**	**A**		

Table 2-16 Signalized Intersection Capacity Analysis Summary (Evening Peak Hour) cont.

Movement		Veh. Delay[1]	LOS[2]	Avg. Q[3]	Max. Q[4]
Arsenal Street at Arlington Street/ Coolidge Ave/ Home Depot Driveway					
Arsenal Street	EB LT	55	D	40	215
Arsenal Street	EB TH-TH/RT	48	D	75	297
Arsenal Street	WB LT	59	E	33	263
Arsenal Street	WB TH-TH/RT	44	D	85	346
Home Depot Driveway	NB LT/TH	36	D	28	152
Home Depot Driveway	NB RT	40	D	28	152
Coolidge Avenue	SWB LT/TH-TH/RT	38	D	17	111
Arlington Street	SEB LT/TH-TH/RT	35	C	39	181
	Overall	**44**	**D**		
Arsenal Street at Greenough Boulevard (North)					
Arsenal Street	EB LT	53	D	14	205
Arsenal Street	EB TH-TH	256	F	277	708
Arsenal Street	WB TH-TH	45	D	57	326
Arsenal Street	WB RT	3	A	0	0
Greenough Boulevard	SB LT-LT/RT	210	F	53	201
Greenough Boulevard	SB RT	33	C	42	211
	Overall	**>120**	**F**		
Arsenal Street/Western Avenue at Soldiers Field Road/ Birmingham Parkway					
Arsenal Street	EB LT/TH-TH/RT	70	E	684	728
Western Avenue	WB LT/TH-TH/RT	236	F	534	1,172
Birmingham Parkway	NB LT-LT	51	D	90	340
Birmingham Parkway	NB TH	47	D	57	319
Birmingham Parkway	NB RT	54	D	84	359
Soldiers Field Road WB Off-Ramp	SB LT/TH	73	E	57	341
Soldiers Field Road WB Off-Ramp	SB TH/RT	59	E	26	341
	Overall	**111**	**F**		

Source: VHB, Inc. using VISSIM Software
1 – Average Delay, in seconds per vehicle
2 – Level of Service
3 – Average queue length estimate, in feet
4 – Maximum queue length estimate, in feet
EB = Eastbound, WB = Westbound; NB = Northbound; SB = Southbound; NWB= Northwestbound; SEB = Southeastbound; SWB = Southwestbound
LT = Left-turn; TH = Through; RT = Right-turn

Unsignalized Intersections Results

The morning and evening peak hour VISSIM results for the seven unsignalized intersections in the study area are presented in Table 2-17 and Table 2-18 respectively. The tables summarize the delay, level of service, average queues and maximum queues for each lane group, as well as the intersection as a whole.

As shown, all of the unsignalized intersections are currently operating at acceptable levels of service under existing conditions.

Table 2-17 Unsignalized Intersection Capacity Analysis Summary (Morning Peak Hour)

Movement		Veh. Delay[1]	LOS[2]	Avg. Q[3]	Max. Q[4]
North Beacon Street at Alfred Street					
North Beacon Street	EB TH/RT	0	A	0	0
North Beacon Street	WB LT/TH	2	A	0	20
Alfred Street	NB LT/ RT	6	A	1	57
	Overall	**5**	**A**		
Mount Auburn Street at Taylor Street					
Mount Auburn Street	EB LT/TH-TH	1	A	0	48
Mount Auburn Street	WB TH-TH/RT	6	A	11	184
Taylor Street	NB LT/TH/RT	11	B	1	48
	Overall	**4**	**A**		
Arsenal Street at Patten Street					
Arsenal Street	EB LT/TH	1	A	0	47
Arsenal Street	WB TH/RT	0	A	0	0
Patten Street	SB LT/RT	14	B	9	97
	Overall	**3**	**A**		
Arsenal Street at Louise Street					
Arsenal Street	EB TH/RT	1	A	1	101
Arsenal Street	WB LT/TH	9	A	40	202
Louise Street	NB LT/RT	25	C	4	76
	Overall	**6**	**A**		
Arsenal Street at Arsenal Mall/ Watertown Mall					
Arsenal Street	EB RT	0	A	0	0
Arsenal Mall Driveway	NB RT	9	A	0	24
	Overall	**-**	**-**		

Table 2-17 Unsignalized Intersection Capacity Analysis Summary (Morning Peak Hour) cont.

Movement		Veh. Delay[1]	LOS[2]	Avg. Q[3]	Max. Q[4]
Arsenal Street at Elm Street					
Arsenal Street	EB LT	0	A	0	0
Arsenal Street	EB TH-TH	1	A	0	0
Arsenal Street	WB TH-TH/RT	0	A	0	0
Elm Street	SB LT/RT	10	A	2	48
	Overall	**1**	**A**		
Arsenal Street at Greenough Boulevard (South)					
Arsenal Street	EB TH-TH/RT	84	F	353	660
Arsenal Street	WB LT/TH-TH	5	A	11	165
Greenough Boulevard	NB LT/RT	34	D	26	186
	Overall	**53**	**D**		

Source: VHB, Inc. using VISSIM Software
1 – Average Delay, in seconds per vehicle
2 – Level of Service
3 – Average queue length estimate, in feet
4 – Maximum queue length estimate, in feet
EB = Eastbound, WB = Westbound; NB = Northbound; SB = Southbound;
LT = Left-turn; TH = Through; RT = Right-turn

Table 2-18 Unsignalized Intersection Capacity Analysis Summary (Evening Peak Hour)

Movement		Veh. Delay[1]	LOS[2]	Avg. Q[3]	Max. Q[4]
North Beacon Street at Alfred Street					
North Beacon Street	EB TH/RT	0	A	0	0
North Beacon Street	WB LT/TH	8	A	44	764
Alfred Street	NB LT /RT	10	A	1	54
	Overall	**9**	**A**		
Mount Auburn Street at Taylor Street					
Mount Auburn Street	EB LT/TH-TH	1	A	0	76
Mount Auburn Street	WB TH-TH/RT	1	A	0	73
Taylor Street	NB LT/TH/RT	11	B	1	50
	Overall	**1**	**A**		
Arsenal Street at Patten Street					
Arsenal Street	EB LT/TH	1	A	5	71
Arsenal Street	WB TH/RT	0	A	0	0
Patten Street	SB LT/RT	11	B	3	65
	Overall	**1**	**A**		
Arsenal Street at Louise Street					
Arsenal Street	EB TH/RT	1	A	0	64
Arsenal Street	WB LT/TH	6	A	18	126
Louise Street	NB LT/RT	10	A	3	54
	Overall	**4**	**A**		

Table 2-18 Unsignalized Intersection Capacity Analysis Summary (Evening Peak Hour) cont.

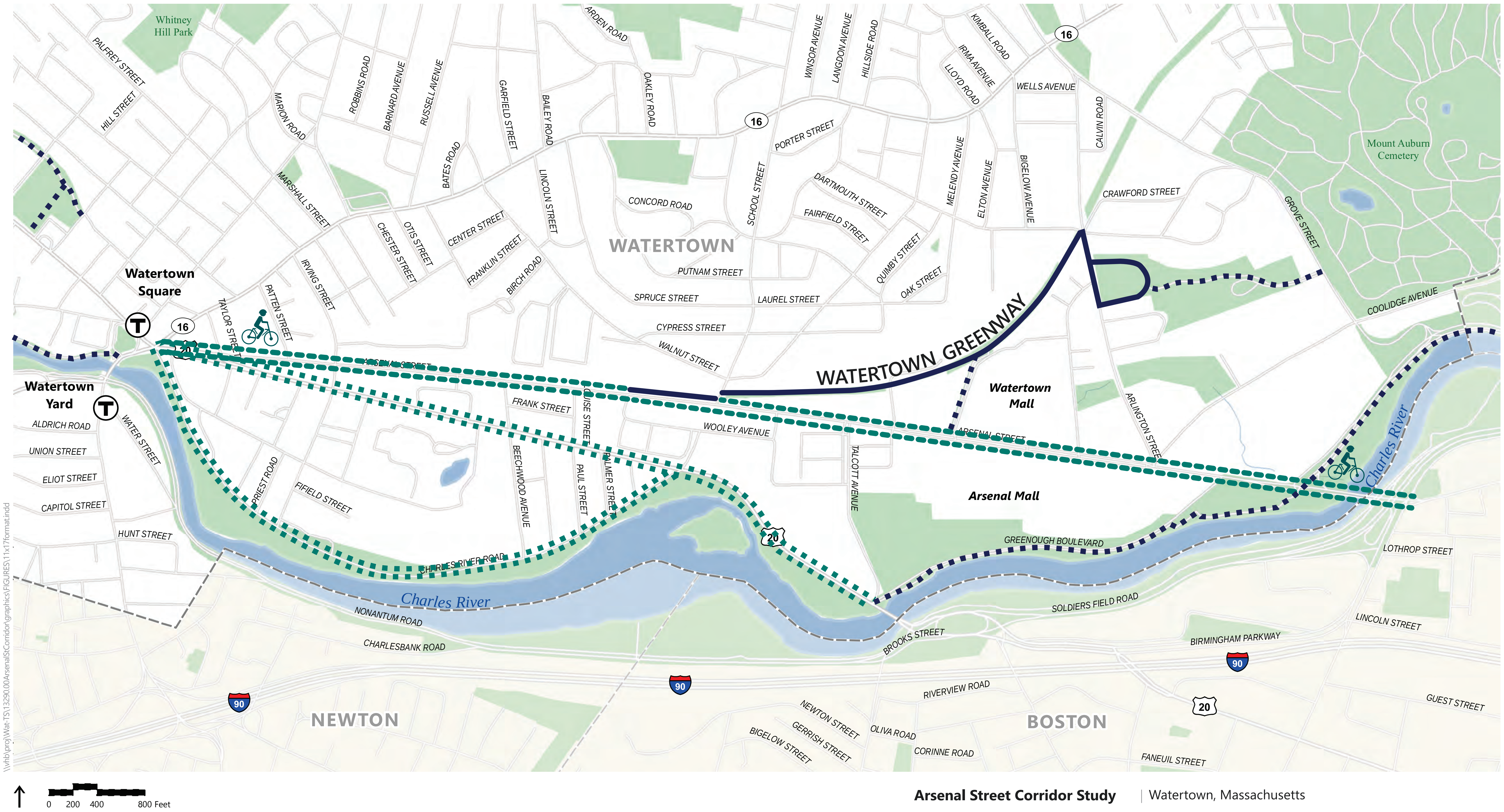
Movement		Veh. Delay[1]	LOS[2]	Avg. Q[3]	Max. Q[4]
Arsenal Street at Arsenal Mall/ Watertown Mall					
Arsenal Street	EB RT	0	A	0	0
Arsenal Mall Driveway	NB RT	15	B	1	47
	Overall	**-**	**-**		
Arsenal Street at Elm Street					
Arsenal Street	EB LT	3	A	0	47
Arsenal Street	EB TH-TH	0	A	0	0
Arsenal Street	WB TH-TH/RT	1	A	0	91
Elm Street	SB LT/RT	11	B	5	99
	Overall	**2**	**A**		
Arsenal Street at Greenough Boulevard (South)					
Arsenal Street	EB TH-TH/RT	4	A	0	72
Arsenal Street	WB LT/TH-TH	5	A	3	236
Greenough Boulevard	NB LT/RT	15	B	8	119
	Overall	**5**	**A**		

Source: VHB, Inc. using VISSIM Software
1 – Average Delay, in seconds per vehicle
2 – Level of Service
3 – Average queue length estimate, in feet
4 – Maximum queue length estimate, in feet
EB = Eastbound, WB = Westbound; NB = Northbound; SB = Southbound;
LT = Left-turn; TH = Through; RT = Right-turn

Bicycle and Pedestrian Assessment

Bicycle Accommodations

Bicycle accommodations connecting to and along Arsenal Street include shared lanes, on-road bicycle lanes and off-road bicycle (or multi-use) accommodations and are graphically presented in Figure 2-14. Along the westbound side of Arsenal Street, off-road bicycle accommodations connecting to the Watertown Greenway are provided in front of Lexus of Watertown. The off-road bicycle accommodation terminates east of Wooley Avenue and continues as on-road bicycle lane to just west of Louise Street. Along eastbound side of Arsenal Street, an on-road bicycle lane is provided just west of Louise Street to Wooley Avenue. Shared lane bicycle accommodations are provided along the remaining portions of the Arsenal Street corridor.



Arsenal Street Corridor Study | Watertown, Massachusetts

Bicycle Accommodations

Source: MassGIS

- ▬ Off-road Bike Lane
- ▬ On-road Bike Lane
- ▪▪▪ Shared Lane Bike Accommodation

Pedestrian Accommodations

Pedestrian accommodations were evaluated along the Arsenal Street corridor and are illustrated in Figure 2-15. Sidewalks are provided along both sides of Arsenal Street, and crosswalks are available at all study area intersections, except for the eastern project limits at Birmingham Parkway. In general, sidewalks along the corridor are in good to fair condition. However, uneven sidewalk surfaces have been observed in several locations. Trees and telephone poles are located in the center of the sidewalk in some locations and can inconvenience all sidewalk users. Examples of locations with these impediments can be found in the Appendix.

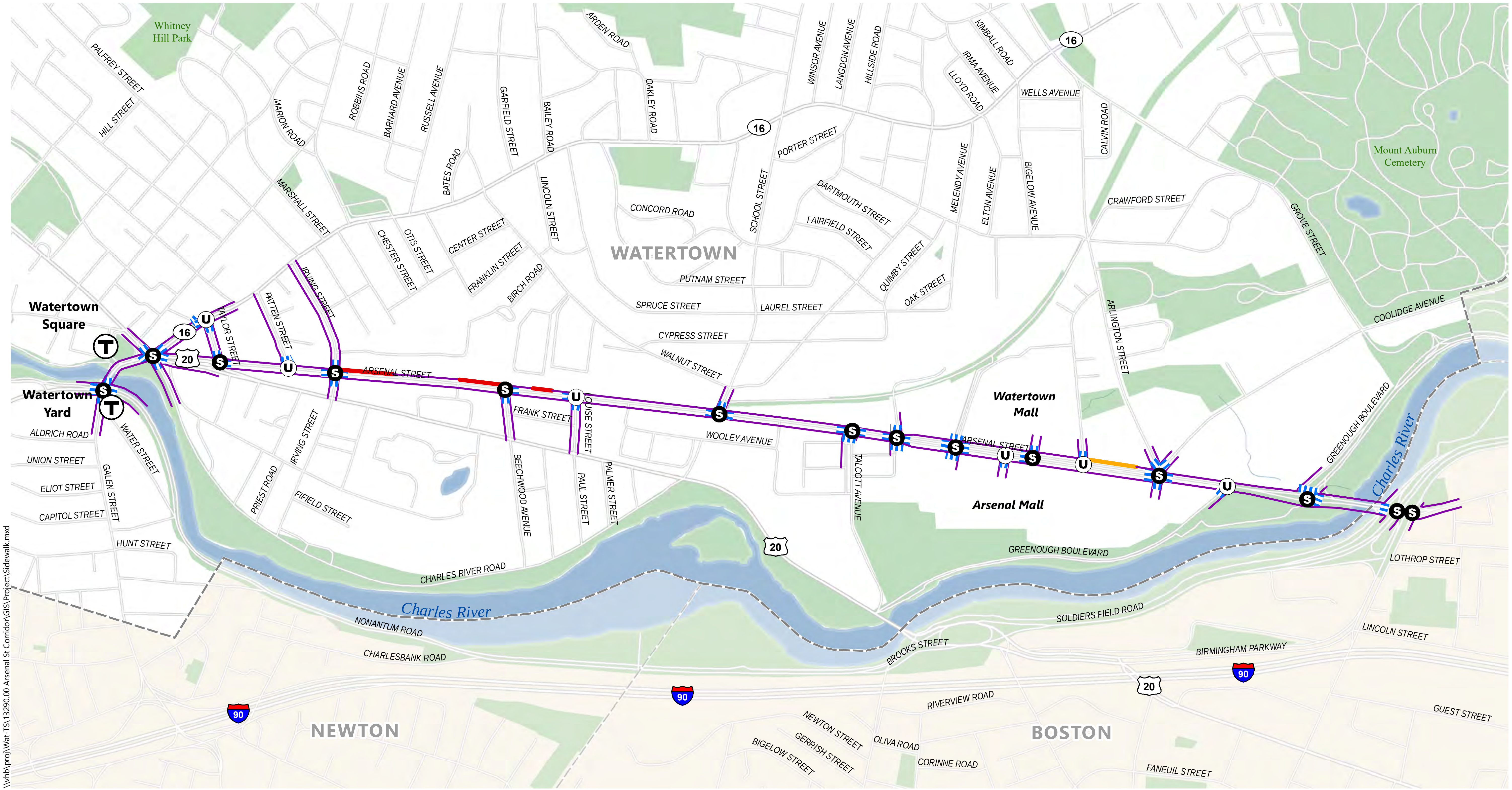
Crosswalks are provided along most stop and traffic signal controlled intersection approaches. Crosswalk treatments/striping vary throughout the corridor and could benefit from a cohesive pattern or aesthetic improvements.

Curb Ramp Audit

VHB inventoried curb ramps within the study area in November 2015. In total, 91 ramps were rated for overall condition (good, fair, or poor) and four key attributes were reviewed for compliance with current Americans with Disabilities Act Accessibility Guidelines (ADAAG) and Massachusetts Architectural Access Board (AAB) regulations:

- Tactile Warning Strip
- Slope
- Clear Path
- Level Landing

The results of the curb ramp audit are presented graphically in Figure 2-16 and are included in the Appendix. As shown, approximately 18 percent of the ramps are in good condition, 72 percent are in fair condition, and 10 percent are in poor condition. Based on the inventory, 17 of the 91 ramps (19 percent) are fully compliant. Of the non-compliant ramps, 37 locations are only lacking a tactile warning strip with the other features meeting current regulations. Addition of a tactile warning strip at these locations would make the ramp fully compliant.



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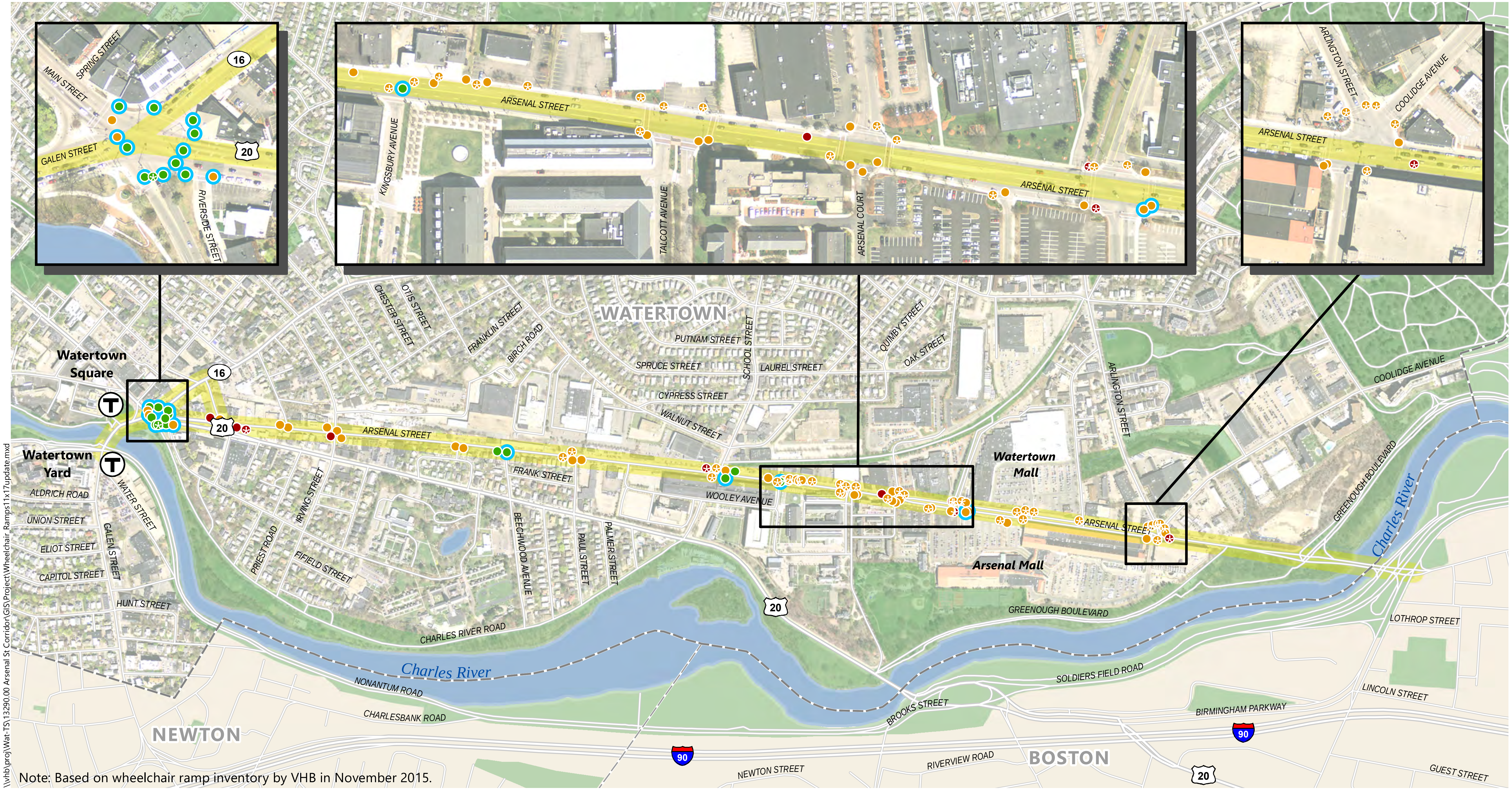
↑ 0 200 400 800 Feet

- Ⓢ Signalized Study Intersection
- Ⓤ Unsignalized Study Intersection
- ▮▮▮ Crosswalk
- — Sidewalk
- — Sidewalk with Deficiencies
- — Under Construction

Arsenal Street Corridor Study | Watertown, Massachusetts

Sidewalk and Crosswalk Inventory

Source: MassGIS



Note: Based on wheelchair ramp inventory by VHB in November 2015.

0 200 400 800 Feet

Arsenal Street Corridor

Ramp Condition

- ● Good
- ● Fair
- ● Poor

Ramp Compliance

- ● Fully Compliant
- ✲ Short-Term Eligible (only tactile warning strip needed)

Arsenal Street Corridor Study | Watertown, Massachusetts

Curb Ramp Inventory

Source: MassGIS, VHB

Bicycle and Pedestrian Demands

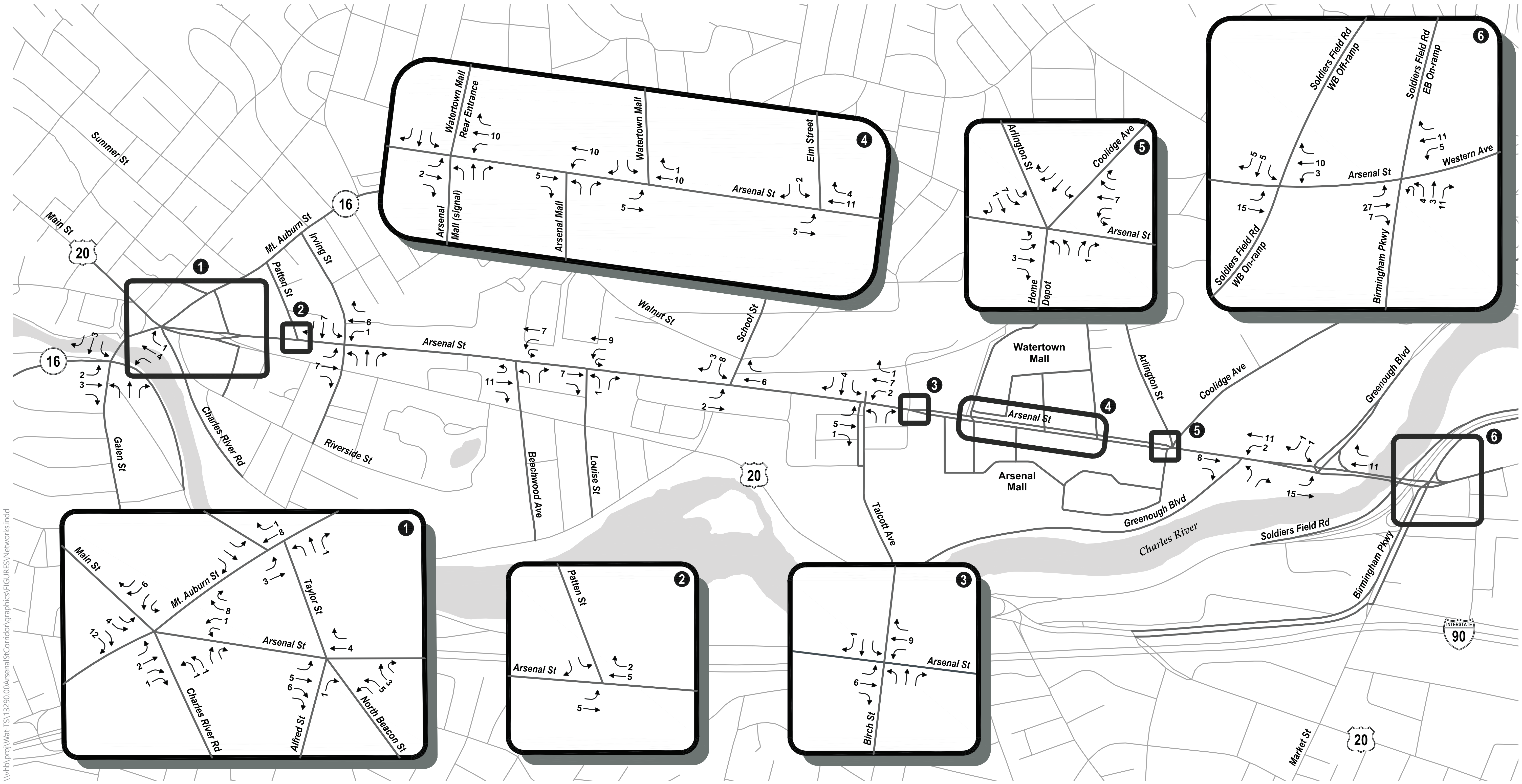
Bicycle and pedestrian volumes were collected at key intersections to quantify pedestrian and bicycle demands along the Corridor. Weekday morning and evening peak hour bicycle and pedestrian volumes are illustrated in Figures 2-17 through Figure 2-20. Bicycle and pedestrian volume data is included in the Appendix.

The highest number of pedestrian crossings is at the intersection of Galen Street at Watertown Street/Nonantum Road, adjacent to the Watertown Bus Yard, with over 400 pedestrians recorded during both morning and evening peak hours.

Safety

To identify potential vehicle crash trends and/or roadway deficiencies within the Local Study Area, a review of the Massachusetts Department of Transportation (MassDOT) Crash Database was conducted to document the number of vehicular collisions that have taken place over the most recent three years (2011-2013).
Using the weekday evening peak hour traffic volumes, combined with other observed traffic data, the number of crashes in the three-year total allows for the calculation of standardized crash rates for intersections. The calculation of intersection crash rate is an effective tool to measure and compare the relative safety of an intersection to other, similar intersections. The resulting crash rate is expressed in million entering vehicles (MEV), which is an industry standard to the traffic engineering profession. It relates to how many crashes occur at a particular intersection for every million vehicles that pass through it.

By way of comparison, the 2013 MassDOT average crash rates for signalized and unsignalized intersections for District 6 (the MassDOT district designation for Watertown) are 0.76 and 0.58, respectively. These rates imply that, on average, 0.76 crashes occurred per million vehicles entering signalized intersections throughout District 6, and 0.58 crashes occurred per million vehicles entering unsignalized intersections in the District. Any crash rate higher than these factors may indicate a higher than average crash tendency for a given facility or intersection. It should be noted that the location for some crashes cannot be precisely determined from the available information and that crashes that are not reported or involved only property damage in an amount less than $1,000 are not included in the database and therefore not considered. Table 2-19 presents the number of crashes, crash characteristics, as well as the crash rate for each of the study area intersections.



Not to scale

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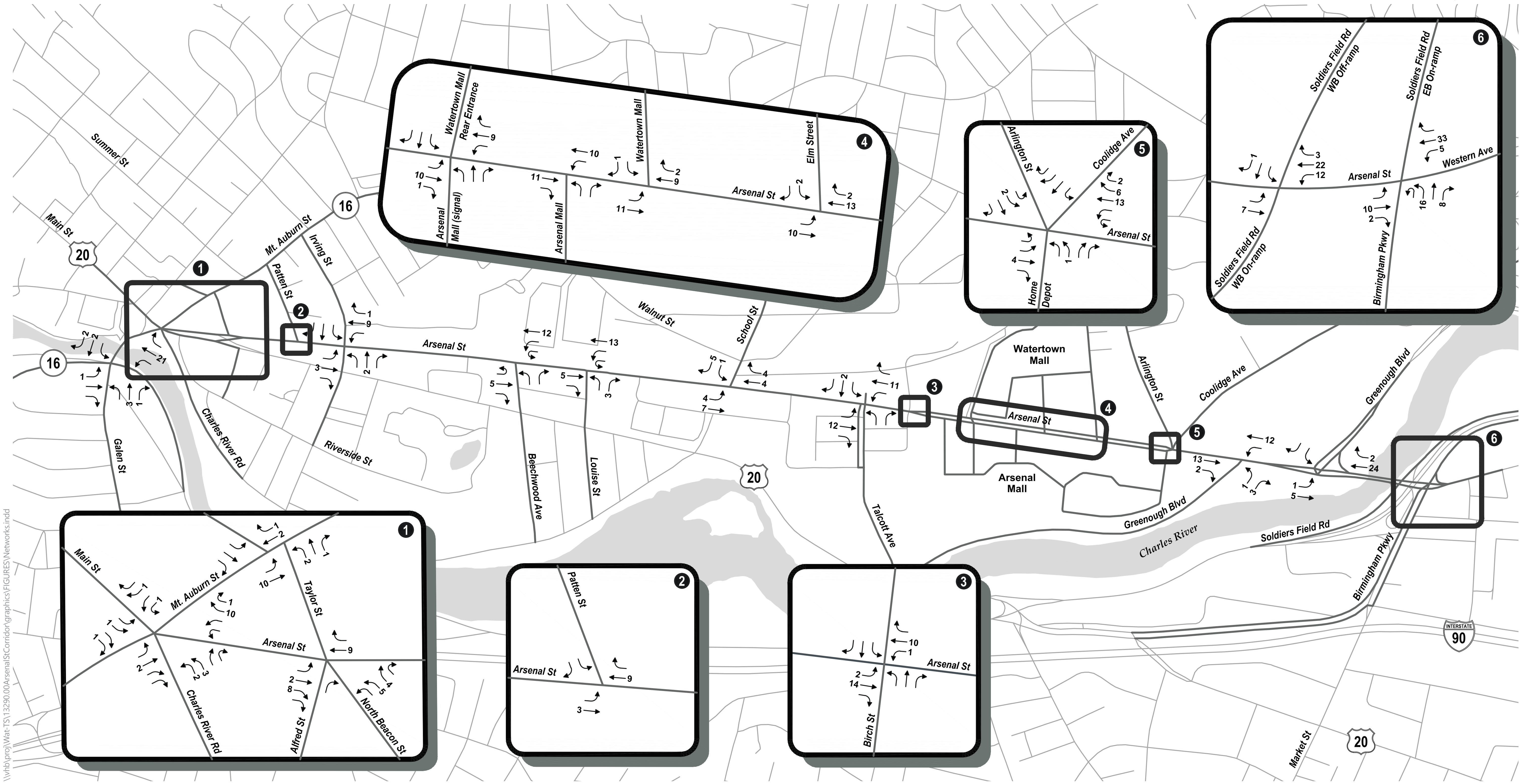
Arsenal Street Corridor Study | Watertown, Massachusetts

2015 Existing Condition
Weekday Morning Peak Hour
Bicycle Volume

Source: MassGIS

Apr 4, 2017 | **FIGURE 2-18**



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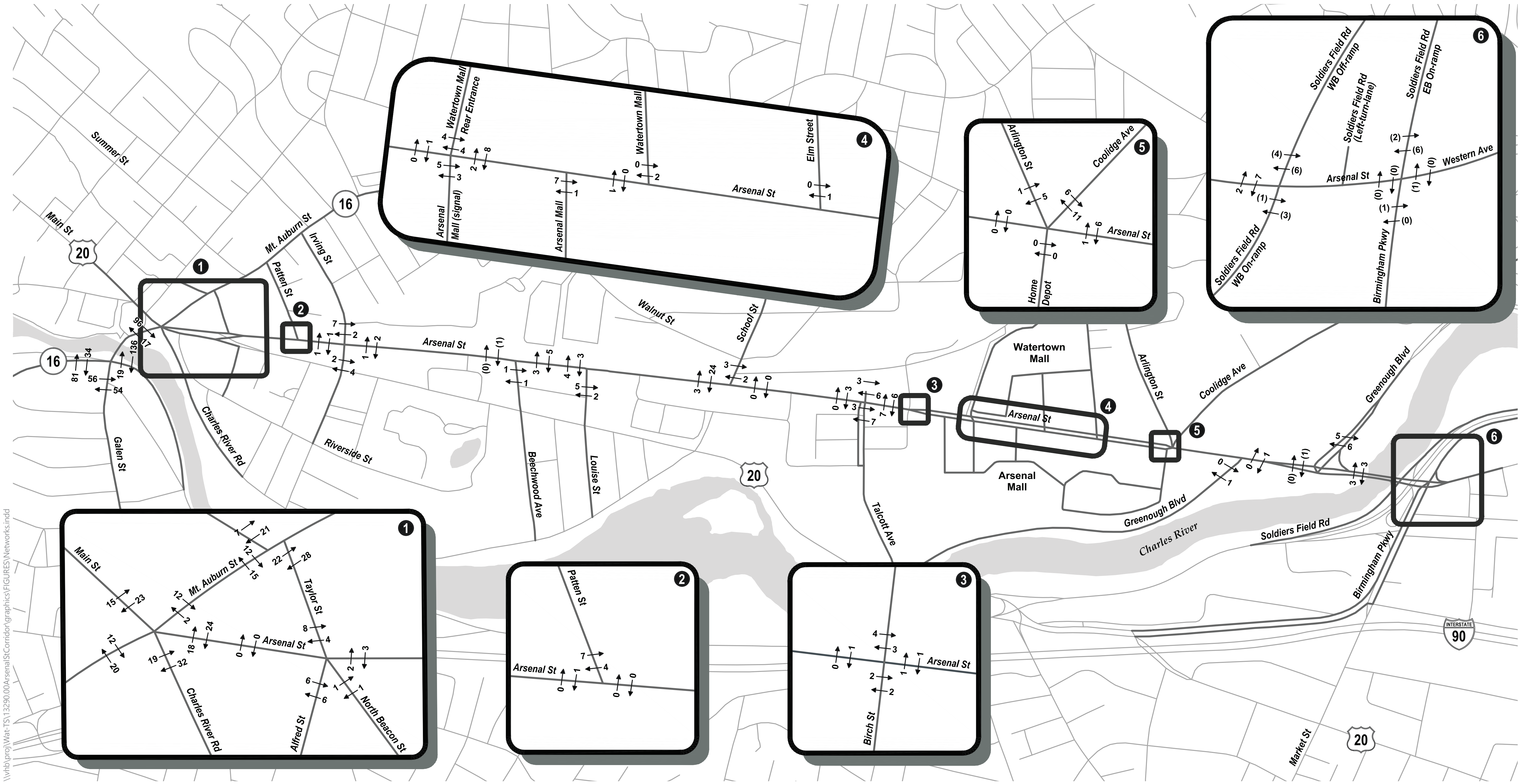
Arsenal Street Corridor Study | Watertown, Massachusetts

2015 Existing Condition
Weekday Evening Peak Hour
Bicycle Volume

Source: MassGIS



Not to scale

(XX) Number of Pedestrians not in Crosswalk
XX Number of Pedestrians

Arsenal Street Corridor Study | Watertown, Massachusetts

2015 Existing Condition
Weekday Morning Peak Hour
Pedestrian Volume

Source: MassGIS

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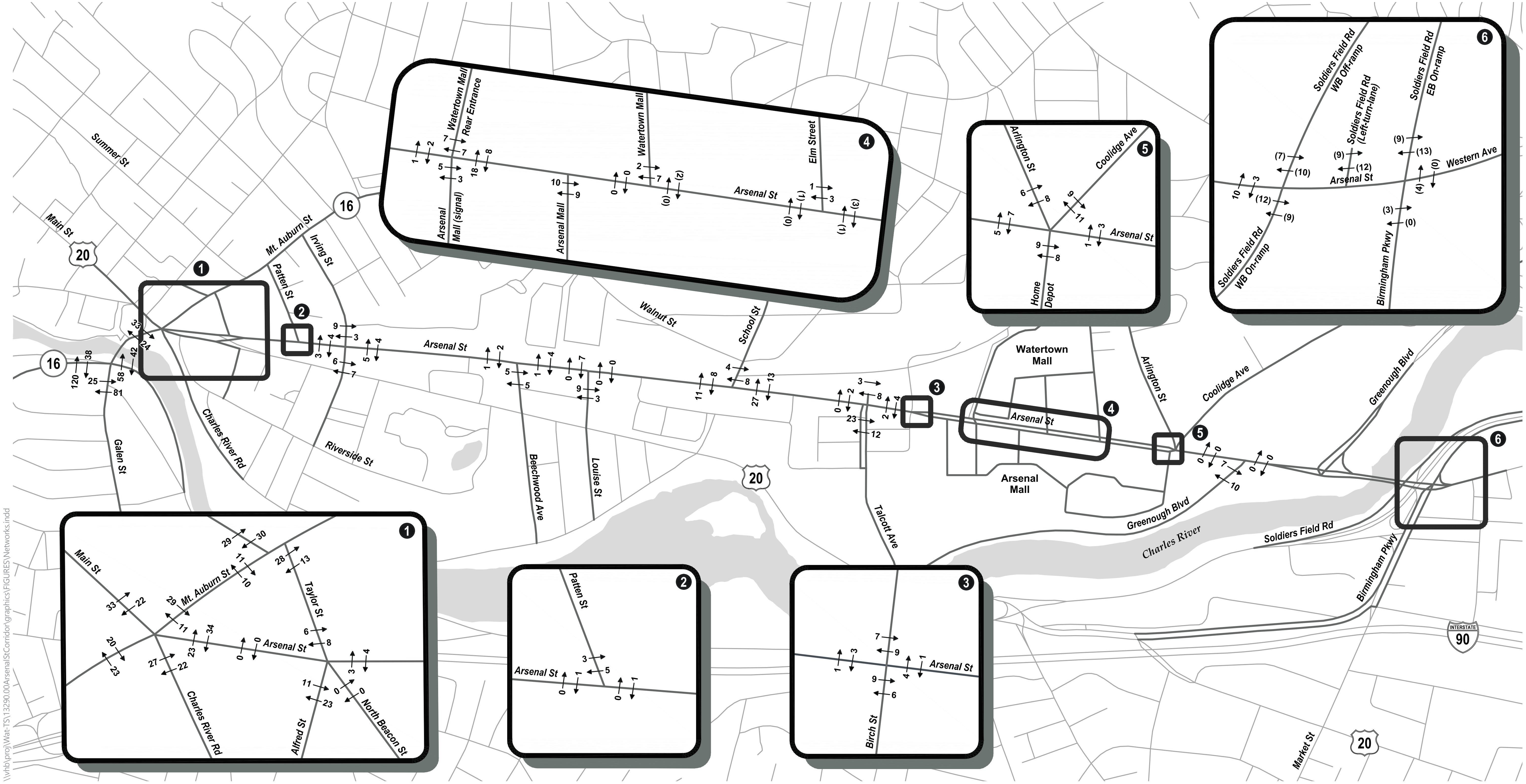

(XX) Number of Pedestrians not in Crosswalk
XX Number of Pedestrians

Arsenal Street Corridor Study | Watertown, Massachusetts

2015 Existing Condition
Weekday Evening Peak Hour
Pedestrian Volume

Source: MassGIS

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Table 2-19 Vehicular Crash Summary 2011-2013

	Galen Street at Watertown Street/ Nonantum Road	Mount Auburn Street/ Main Street/ Arsenal Street/ Charles River Road	Arsenal Street at North Beacon Street/ Taylor Street	Mount Auburn Street at Taylor Street	Arsenal Street at															Western Ave at Birmingham Parkway
					Patten Street	Irving Street	Beechwood Ave	Louise Street	School Street	Roma Tile Driveway/ Talcott Avenue	Birch Street/ Arsenal Court	Arsenal Mall Rear Entrance	Arsenal Mall unsignalized driveway	Watertown Mall	Elm Street	Arlington Street/ Coolidge Avenue	Greenough Boulevard (south)	Greenough Boulevard (north)	Soldiers Field Road	
Currently Signalized	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes
Average Crash Rate	0.76	0.76	0.76	0.58	0.58	0.76	0.76	0.58	0.76	0.76	0.76	0.76	0.58	0.76	0.58	0.76	0.58	0.76	0.76	0.76
Calculated Crash Rate	0.92	0.77	0.26	0.12	0.14	0.44	0.13	0.23	0.47	0.35	0.20	0.00	1.11	0.35	0.62	0.38	0.92	0.24	0.23	0.49
Exceed?	**Yes**	**Yes**	No	No	No	No	No	No	No	No	No	No	**Yes**	No	**Yes**	No	**Yes**	No	No	No
Year																				
2011	13	12	5	1	1	5	1	0	4	4	0	0	10	0	6	6	7	3	2	6
2012	17	19	1	1	0	0	1	2	6	4	4	0	9	3	4	3	11	3	2	6
2013	11	12	0	0	1	5	0	2	4	1	1	0	4	5	3	3	8	2	3	8
Total	41	43	6	2	2	10	2	4	14	9	5	0	23	8	13	12	26	8	7	20
Collision Type																				
Angle	17	18	2	0	2	6	0	2	6	2	3	0	11	4	11	2	9	4	2	13
Head-on	3	2	1	0	0	0	0	0	0	0	0	0	4	0	2	0	2	0	0	0
Rear-end	7	9	1	2	0	3	1	2	6	4	1	0	4	3	0	8	9	3	2	1
Rear-to-Rear	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sideswipe, opposite direction	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Sideswipe, same direction	6	3	0	0	0	1	0	0	1	0	0	0	0	1	0	1	3	0	2	0
Single vehicle crash	5	9	1	0	0	0	0	0	1	2	1	0	4	0	0	1	3	1	1	6
Unknown/ Not Reported	2	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Total	41	43	6	2	2	10	2	4	14	9	5	0	23	8	13	12	26	8	7	20
Crash Severity																				
Fatal injury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-fatal injury	15	13	2	1	1	2	1	2	8	4	2	0	9	2	4	5	8	1	4	5
Property damage only (none injured)	26	29	4	1	1	8	1	2	6	4	2	0	14	6	9	7	17	7	3	14
Not Reported/Unknown	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	1
Total	41	43	6	2	2	10	2	4	14	9	5	0	23	8	13	12	26	8	7	20
Time of Day												0								
Weekday, 7:00 AM - 9:00 AM	5	7	0	0	0	3	0	1	1	1	0	0	3	0	0	3	5	0	3	5
Weekday, 4:00 PM - 6:00 PM	4	7	3	0	0	0	1	0	4	1	1	0	2	0	2	1	6	2	0	6
Saturday, 11:00 AM - 2:00 PM	2	2	0	0	0	0	0	1	0	0	0	0	0	2	1	0	0	0	0	2
Weekday, other time	24	20	3	1	0	6	1	2	7	5	4	0	11	3	7	5	13	2	2	4
Weekend, other time	6	7	0	1	2	1	0	0	2	2	0	0	7	3	3	3	2	4	2	3
Total	41	43	6	2	2	10	2	4	14	9	5	0	23	8	13	12	26	8	7	20
Pavement Conditions																				
Dry	36	37	3	2	2	8	1	3	9	7	4	0	20	8	11	10	23	7	6	16
Wet	5	5	3	0	0	2	0	1	4	2	1	0	1	0	2	2	3	1	1	4
Snow	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Ice	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Sand, mud, dirt, oil, gravel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water (standing, moving)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Slush	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Not Reported/Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	41	43	6	2	2	10	2	4	14	9	5	0	23	8	13	12	26	8	7	20
Non Motorist (Bike, Pedestrian)																				
Total	6	9	1	0	0	1	0	0	2	1	0	0	4	1	1	1	0	0	1	0

Source: MassDOT Crash Database 2011-2013

As presented in Table 2-19, no fatalities were recorded at any of the study area intersections. Out of the 20 study area intersections, five locations have crash rates that exceed the District 6 average crash rate. This means that the crash incidents at the remaining 15 locations are similar to other intersections in District 6 when adjusted for traffic volume. The majority of the reported crashes were angle and rear-end collisions that occur during weekday non-peak hours in dry weather. Angle and rear-end crashes are more common at intersections (as opposed to roadway segments) and could be reflective of inattentive driver behavior, frequent lane changes (which are observed at signalized intersections along Arsenal Street), or inadequate (based on current standards) clearance phases at traffic signals. It is notable that these crashes primarily occur outside of peak commuting periods without inclement weather influence, which generally indicates physical roadway characteristics are not a substantive contributing factor. The intersections of Galen Street at Nonantum Road/ Watertown Street and Main Street/ Arsenal Street at Galen Street/ Mount Auburn Street/ Charles River Road, which have the highest level of pedestrian activity within the Local Study Area, account for most of the non-motorist collisions (bike, pedestrian).

For the locations that exceed the crash average, the following observations are noted:

- **Galen Street at Watertown Street/ Nonantum Road** – left-turning vehicles in either direction along Galen Street cause significant back-up, were observed to turn during unacceptable gaps in traffic, and require through motorists to sometimes quickly change lanes. Left-turns are prohibited during peak commuting hours, but this prohibition is widely ignored when a police officer is not present, further contributing to congestion and driver frustration. These left-turns are a likely contributor to the high number of angle crashes occurring. A second contributing factor may be left-turns from Watertown Street, which are permitted against through traffic A high number of bicyclists and pedestrians, at times crossing against the traffic signal or outside of the designated crossing area may require drivers to react to multiple unexpected situations at the same time. MassDOT has recently completed a Roadway Safety Audit at this location.
- **Mount Auburn Street/ Main Street/ Arsenal Street/ Charles River Road** – Particularly along the Mount Auburn Street approaches, vehicles are frequently observed making illegal lane changes and movements from the wrong lane (i.e. right turn movements from an inside through lane or through movements from a left-turn lane). These illegal lane changes are a likely contributor to the high number of angle crashes occurring.
- **Arsenal Street/Arsenal Mall Unsignalized Driveway** – based on the available crash data, which show four head on collisions, crashes at this location seem to be caused by vehicles attempting to take a right-turn out of this driveway and then take an immediate left-turn into the Watertown Mall. This movement, while not expressly prohibited, requires a driver to turn right and cross two lanes of traffic within 200 feet. Another possible contributor

could be vehicles attempting to turn left from the driveway, although crash data do not specifically suggest this.

- **Arsenal Street/Elm Street** – Although the crash rate at this location marginally exceeds the District average, there are no indications or trends in the crash data suggesting crash cause. Left-turning traffic from Elm Street, crossing four travel lanes and a median may contribute to the high number of angle accidents at this location.
- **Arsenal Street/Greenough Boulevard (south)** – Left-turning traffic from Greenough Boulevard to Arsenal Street crosses four travel lanes at this often-congested location. Vehicles are often observed to accept gaps in traffic that are shorter than acceptable for turning left. This may factor into the higher than average number of crashes, particularly angle and rear end.

MassDOT 2013 Top Crash Locations Report

MassDOT published a 2013 Top Crash Locations Report in August of 2015, ranking the Top 200 Intersection Locations based on crash data from the years 2011-2013. In order to determine an intersection's ranking, MassDOT created a comprehensive method to locate crash clusters. This method uses a 25 meter (roughly 82 feet) search distance to locate adjacent crashes, and then merges the areas together to create a crash cluster. The clusters are then named based on the first and second highest functional classification roadways within the cluster and ranked by the number of Equivalent Property Damage Only (EPDO) crashes; where fatal crashes are weighted by 10, injury crashes are weighted by 5, and property damage only and non-reported crashes are weighted by 1. Therefore, each cluster can contain multiple intersections or segments of roadway located near the main intersection. The intersection of Galen Street at Nonantum Road/ Watertown Street is ranked 178 in the 2011-2013 Statewide Top 200 Intersection Crash List.

Highway Safety Improvement Program (HSIP)

The Highway Safety Improvement Program (HSIP) was established under the 'Moving Ahead for Progress in the 21st Century Act (MAP-21) as a Federal-aid funding program to achieve significant reduction in fatalities and serious injuries on all public roads. Projects using HSIP funding are selected based the top five percent regional crash location list and identified in the Strategic Highway Safety Plan (SHSP). An HSIP-eligible cluster is one in which the total number of "equivalent property damage only[6] "crashes in the area is within the top 5 percent of all clusters in that region. Being HSIP-eligible makes the location eligible for FHWA and MassDOT funds to address the identified safety issues at these locations. The intersections of Arsenal Street at Arsenal

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[6] "Equivalent property damage only" is a method of combining the numbers of crashes with the severity of the crashes based on a weighted scale. Crashes involving property damage only are reported at a minimal level of importance, while collisions involving personal injury (or fatalities) are weighted more heavily.

Mall (EPDO: 59) and Arsenal Street at Greenough Boulevard (south) (EPDO: 48) are listed as an HSIP-eligible vehicle clusters in the 2011-2013 HSIP cluster listing. Watertown Square (including the entire Charles River bridge crossing and the intersection at the Watertown Yard) is listed as an HSIP-eligible pedestrian and bicycle cluster. An additional HSIP-eligible bicycle cluster is identified along Arsenal Street and Western Avenue in the vicinity of Birmingham Parkway. This includes the entire Charles River bridge crossing located at the eastern end of the Local Study Area.

Environmental and Social Justice

Natural Resources

Environmental resources in the Study Area include wetlands, waterways and open space. These resources are not only important to the environmental health of the area but also create constraints that are subject to a number of state and federal laws. In the vicinity of the Study Area, the most prominent environmental feature is the Charles River. Within the Study Area the Charles River is contained within a well-defined channel with limited areas of bordering vegetated wetland.

Initial environmental resource mapping for the corridor study and feasibility analysis was developed primarily using Massachusetts Geographic Information System (MassGIS) data[7], which is a part of the Executive Office of Energy and Environmental Affairs (EEA). Once mapping was prepared from the GIS data, field investigations were then conducted by environmental scientists with VHB, to further refine resource area boundaries within the Local Study Area. Resource area mapping included review of wetlands and waterways, floodplains, Bio Map (high priority ecosystems), Living Waters (waterbodies that are viable for freshwater biodiversity), wildlife and protected species habitat, water resources, and hazardous material disposal and release sites.

Wetlands and Waterways

Wetland and waterways resource systems in the Study Area include the Charles River between Galen Street and Arsenal Street at Western Ave, wooded swamps, emergent marshes, streams, ponds, floodplain and floodways. Identified resource areas are depicted in Figure 2-21. The Charles River is the predominate wetland feature in the Study Area. The river has well defined banks and ranges in width from 67 feet wide to almost 900 feet wide. The water level in the Charles River is controlled both by the Amelia Earhart Dam, approximately 5.5 miles downstream of the Western Ave Bridge, and by the Watertown Dam located 900 feet north of Galen Street. Sawins Pond, located between Elm Street and Coolidge, passes under Arlington and Coolidge

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[7] http://www.mass.gov/anf/research-and-tech/it-serv-and-support/ application-serv/office-of-geographic-information-massgis/datalayers/ layerlist.html

Streets before outletting to the Charles at the limit of the project area. Vegetated wetlands including wooded wetlands and marshes, are present along the Sawins Pond and in limited areas of the Charles River although development has altered the extent of wetlands that remain.

Wetland resources in the Study Area are subject to regulation by the Massachusetts Wetlands Protection Act and include Bordering Vegetated Wetland (BVW), Bank, Land Under Water Bodies and Waterways (LUWW), and Riverfront Area. The WPA establishes a 100-foot buffer zone from the limit of BVW and bank, associated with these wetland systems. Additionally, the WPA establishes a 200-foot Riverfront Area from the limit of the mean annual high water line of perennial streams and rivers. The wetland and water resources are also subject to federal jurisdiction pursuant to the Clean Water Act. Any alteration or loss of wetlands or waters will require review and approval from the Watertown Conservation Commission, the Massachusetts Department of Environmental Protection and the U.S. Army Corps of Engineers.

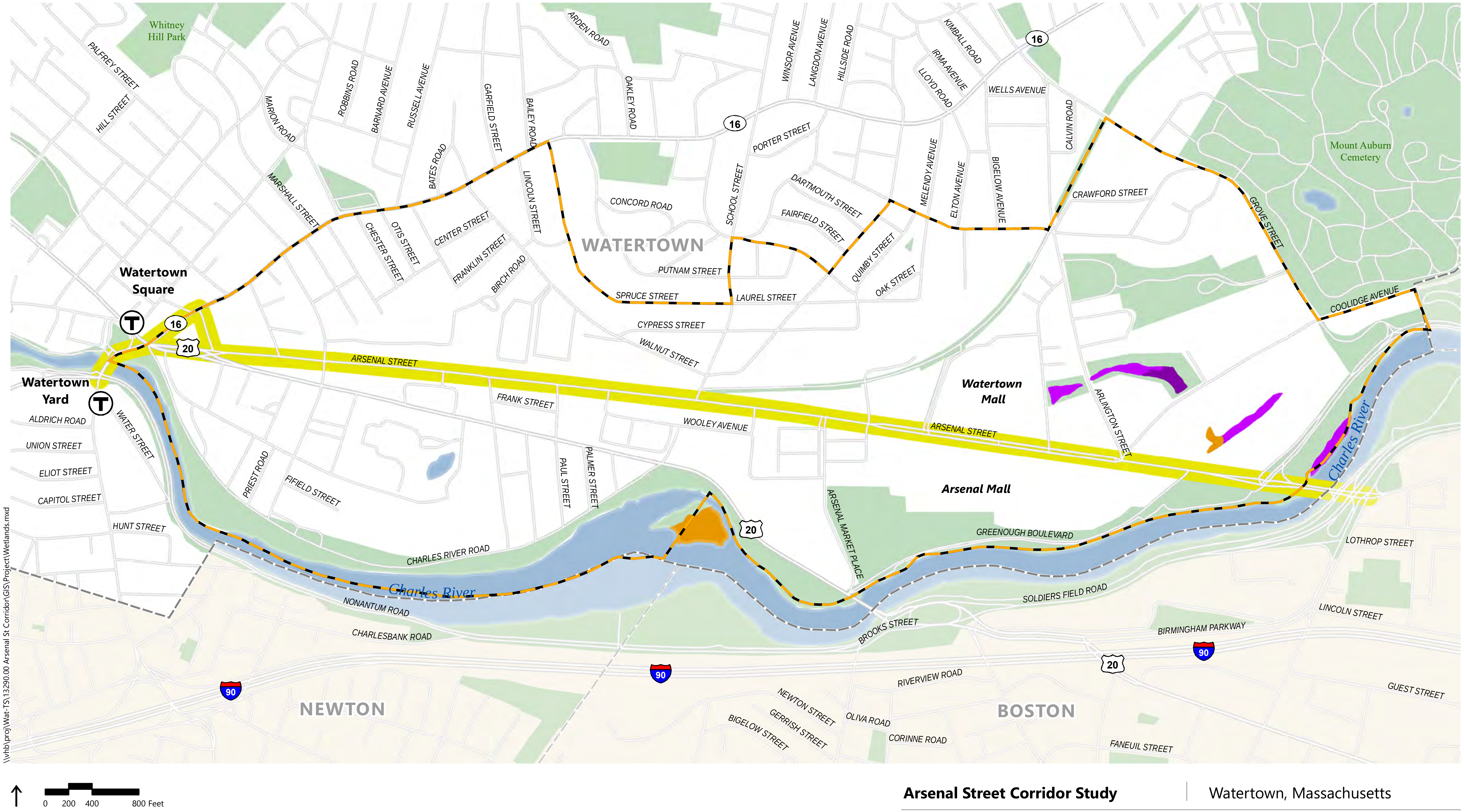
Floodplain

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) identify the zone AE at elevation 4 feet in the Study Area (Figure 2-22). The floodway follows the banks of the Charles River. The 100-year floodplain is regulated by the WPA as Bordering Land Subject to Flooding.

Bio Map and Living Waters

Natural Communities, Supporting Natural Landscapes, Core Habitat and Living Waters data layer from MassGIS was reviewed for the Study Area. No Living Waters or areas of Biomap significance were noted in the vicinity of the Study Area.

Apr 03, 2017 | **FIGURE 2-21**



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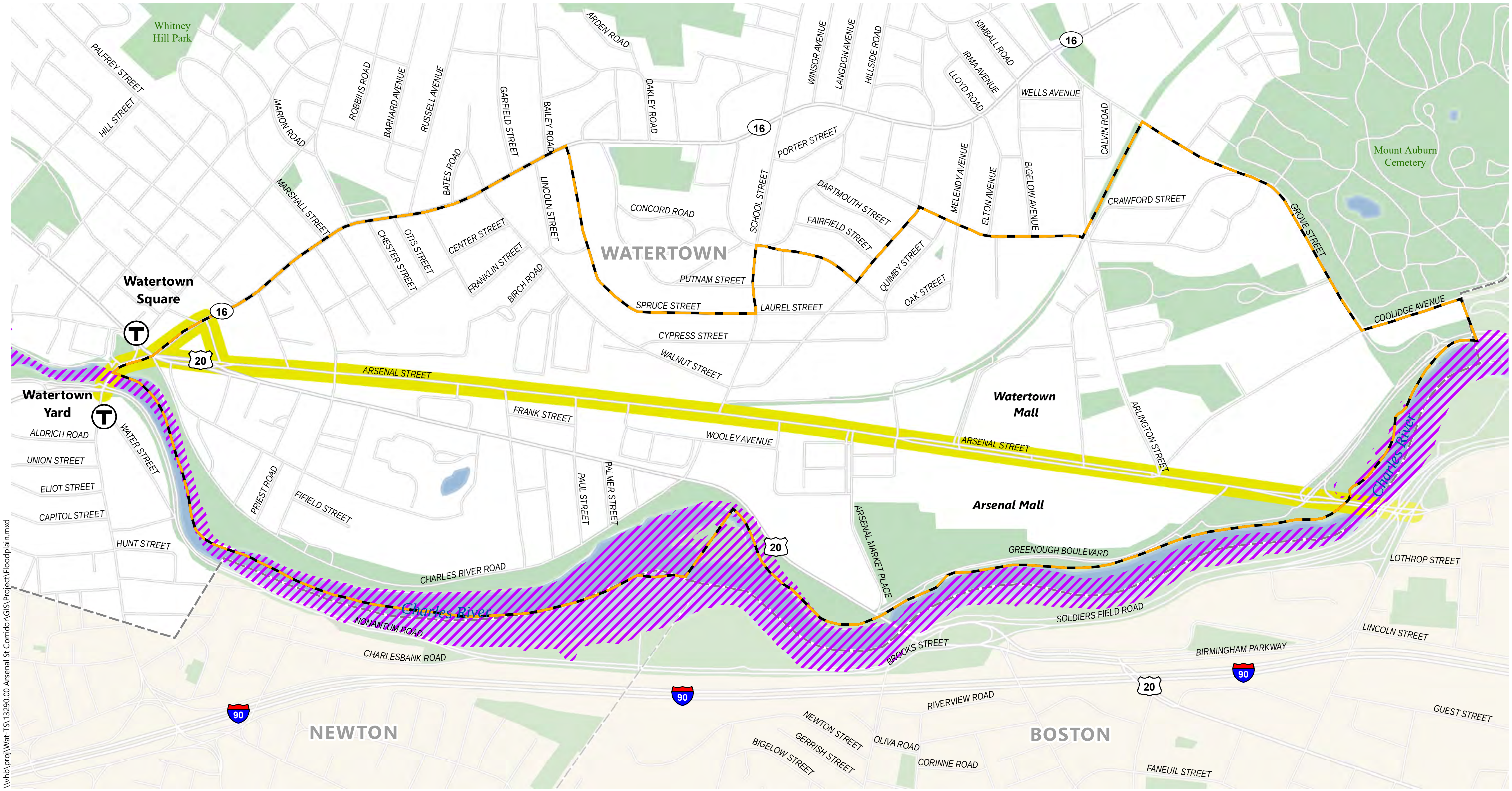
Wetlands

- 🟪 Deep Marsh
- 🟦 Open Water
- 🟪 Shallow Marsh Meadow or Fen
- 🟧 Wooded Swamp Deciduous

- ▭ Local Study Area Boundary
- 🟨 Arsenal Street Corridor

Arsenal Street Corridor Study | Watertown, Massachusetts

Wetland and
Waterways Resource Systems
Source: MassGIS



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↑ 0 200 400 800 Feet

▨ FEMA 100-year Floodplain
▭ Local Study Area Boundary
▬ Arsenal Street Corridor

Arsenal Street Corridor Study | Watertown, Massachusetts

FEMA 100-year Floodplain

Source: MassGIS

Water Resources

Wellhead protection areas (Zone II) are important for protecting water quality in recharge areas that support public water supplies. Certain land uses may be prohibited or restricted in Zone IIs and aquifer areas and stormwater management measures are more stringent. Based on mapping maintained by MassGIS there are no Zone IIs in the Study Area.

Wildlife and Protected Species Habitat

The Natural Heritage and Endangered Species Program (NHESP), part of the Massachusetts Division of Fisheries and Wildlife is responsible for the conservation and protection of endangered, threatened, and species of special concern. Rare species are important for biodiversity and represent elements of an ecological system that are unique or few in number. Rare species are protected by both federal and state laws and include both plants and animals and their critical habitats.

According to the most recently published edition of the Massachusetts Natural Heritage Atlas[8] (October 2008), there are no Priority Habitat of Rare Species, Estimated Habitat of Rare Wildlife that occur within the Local Study Area. One Vernal Pool was noted (in addition to a second just outside the study area boundary), as shown in Figure 2-23.

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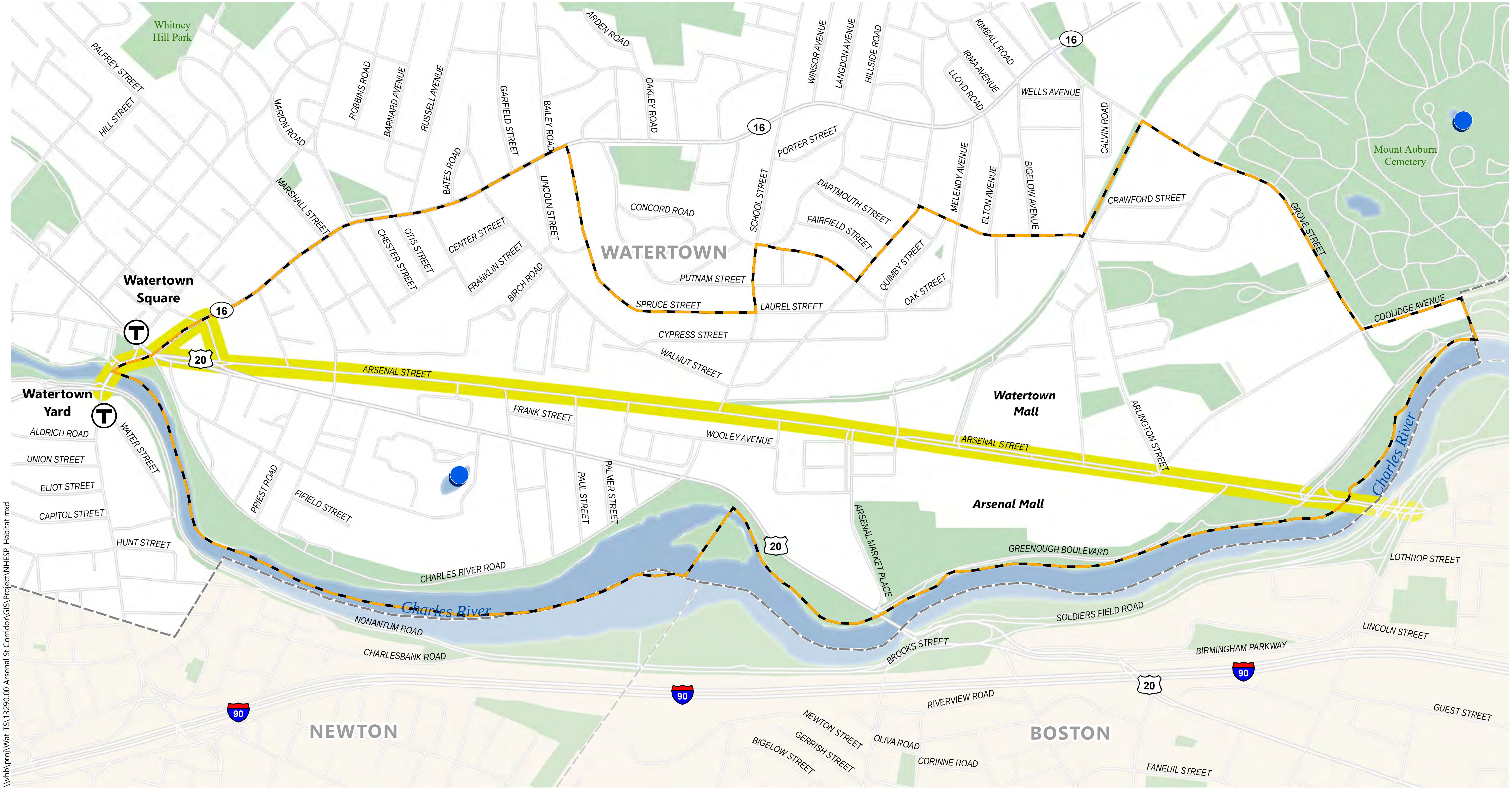
[8] NHESP, 2008. *Massachusetts Natural Heritage Atlas*. 13th Edition.



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● Potential Vernal Pools

▭ Local Study Area Boundary

▬ Arsenal Street Corridor

Note: NHESP Priority Habitat, Estimated Habitat, and Certified Vernal Pools do not fall within the study extents.

Arsenal Street Corridor Study | Watertown, Massachusetts

Rare and Endangered Species

Source: MassGIS

Environmental Justice

The project study considers Environmental Justice (EJ) to enable a fair distribution of any environmental benefits or impacts that could be associated with the recommendations herein. Whether, and to what extent, planned transportation related actions within the Local Study Area may impact minority, low-income or other so designated populations within the Local Study Area are considered, noting the following:

- **Executive Order 12898** indicates that *"its purpose is to focus federal attention on the environmental and human health effects of federal actions on minority and low-income populations with the goal of achieving environmental protection for all communities."*
- **Executive Order 13166** *"requires Federal agencies to examine the services they provide, identify any need for services to those with limited English proficiency (LEP), and develop and implement a system to provide those services so LEP persons can have meaningful access to them."*
- **Title VI of the Civil Rights Act of 1964** *"protects people from discrimination based on race, color and national origin in programs and activities receiving federal financial assistance."* In response, the Federal Transit Administration (FTA) works to ensure non-discriminatory transportation in support of their mission to enhance the social and economic quality of life for all Americans.

Specifically, if the proposed development actions could negatively impact these populations and their quality of life, appropriate mitigation measures must be considered.

The Local Study Area includes a mix of commercial and residential land uses, along with public green and open space. In-field observations noted nominal vacancy and several projects currently under construction or otherwise planned for construction. The Corridor offers both on- and off-street parking and major intersections are signalized. The existing development, as well as that which is under construction and planned, will continue to place demands on public infrastructure. Conversations with representatives of the Watertown Community Development and Planning Department indicate that each of the "new" projects, as part of their permitting and approvals process, are subject to traffic engineering analyses and possible mitigation.

The Massachusetts Executive Office for Administration and Finance indicates that Census 2010 benchmarks for minority population include those block groups where 25 percent or more of the total population reports themselves as a race other than White[9]. If 25 percent or more of the population in the block group meets this benchmark, the block group is an EJ block group. Based on these metrics, the only

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[9] Persons reporting themselves as being of Hispanic heritage are reporting an ethnicity, not a race.

block group in the Local Study Area that is classified as an EJ block group for minority population is census tract/block group 3703.003 with a 25.3 percent minority population in 2010.

The reported statewide 2010 median household income was $62,133 and any household reporting a median income of $40,673 or less is considered an EJ household. If the median household income of a block group or $40,673 or less, the block group is considered an EJ block group. In 2010, all Local Study Area block groups reported median household incomes exceeding $40,673; therefore, none of the block groups in the Local Study Area are benchmarked as a low-income population.

A household in which no person 14 years or older speaks only English and no person 14 years or older who speaks a language other than English speaks English "very well" is classified as "linguistically isolated." All members of a linguistically isolated household are tabulated as isolated, including members under 14 years old who may speak only English. Based on this metric, none of the block groups in the Local Study Area are considered linguistically isolated.

Detailed socioeconomic indicators and other metrics relative to Environmental Justice are presented in greater detail in the Appendix and key statistics include:

- The racial and cultural diversity of the Local Study Area and the Region are very similar, although the Local Study Area has a nominally lesser representation of persons' not-of-color. The overall population of the Local Study Area is 79.8 percent White, compared with 76.6 percent in the Region. As a result, while the Corridor population accounts for 6.1 percent of the total Region population, it accounts for 6.3 percent of the Region's White population.
- At 15.6 percent of the population, the Local Study Area population aged 65 and older is marginally greater than the 13.2 percent in the Region. The Local Study Area accounts for 7.2 percent of the Region population aged 65 and older.
- The number of households in the Local Study Area accounts for 6.7 percent of Region households, a representation slightly greater than the population. This is likely attributed to a higher percentage of renter occupied households in the Local Study Area (at 59.2 percent) when compared with the Region (at 55.5 percent).
- The median household income in the Local Study Area is approximately $75,700, on par with the Region median household income of $78,800. The percentage of households in the Local Study Area earning less than $35,000, at 23 percent, is similar to the Region at 22.5 percent.

- There are fewer households (as a percent of total households) in the Local Study Area with no vehicles available when compared with the Region, at 14.3 percent and 16 percent, respectively.
- The MassDOT Title VI interactive map[10] indicates that English is by far the primary language spoken in the Town of Watertown. Armenian is the only language spoken by more than 5 percent of the Watertown population (primarily located in East Watertown).

The selected socioeconomics of the Local and Regional Study Areas are reasonably similar across most metrics, although there is a slightly higher concentration of renter-occupied housing in the Local Study Area. Considering the development projects that are currently under construction in the Local Study Area, as well as those that are known and planned, this variance may increase in the near term[11].

Based on the findings identified above, there is not currently an imbalance in the socioeconomic "make-up" of the Local Study Area when compared with the Region, as the diversity and composition of their respective populations are similar regarding racial and ethnic composition, as well as relative incomes. Improvements to the corridor in the form of traffic and/or public transportation enhancements would be expected to improve accessibility to the residential, employment centers, health and hospital services, public space, commerce and hospitality uses in the area, irrespective of the socioeconomic profile of Local Study Area residents and establishments.

Historic and Cultural Resources

The review of existing resources within the local study area includes identifying properties that are either in the Inventory of Historic and Archaeological Assets of the Commonwealth (Inventory) or listed in the National or State Registers (NR or SR) of Historic Places that are within the Arsenal Street Corridor (Local Study Area) or are within proximity. A search of the Massachusetts Historical Commission's (MHC) Massachusetts Cultural Resource Information System (MACRIS) database and mapping tool (MACRIS Maps) was completed to identify previously recorded above-ground and archaeological resources located on or adjacent to the Project Corridor. The findings of this search are provided in the Appendix.

In summary, there are inventoried properties within the Project vicinity, including some listed in the National Register of Historic Places. As shown in Figure 2-24, the majority of properties are located on the south side of the Arsenal Street corridor. Effects to the properties would be minimal if work occurs on the north side of the corridor. If project work occurs within the existing paved roadway and sidewalk, effects will be minimal as well.

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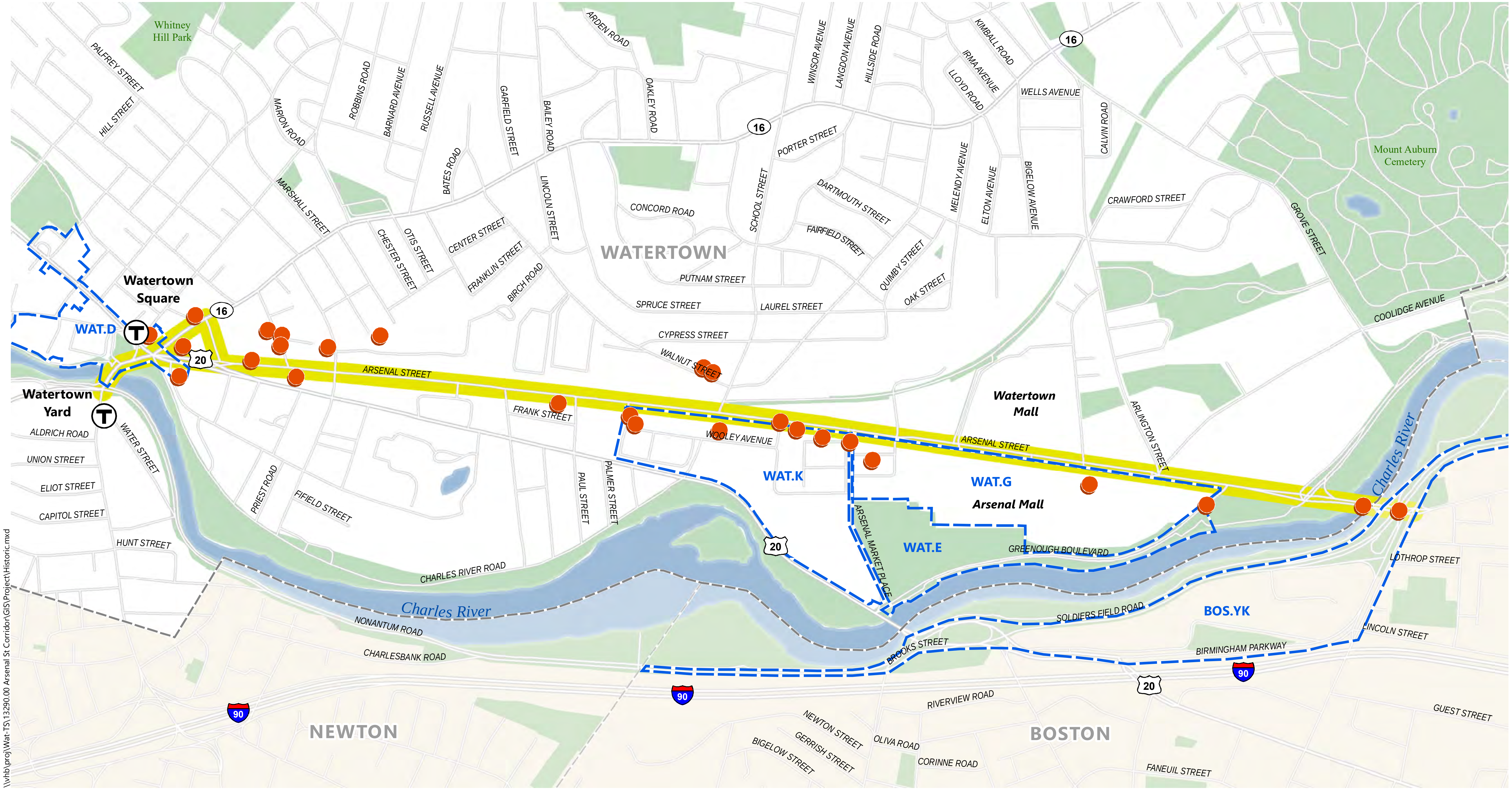
[10] http://services.massdot.state.ma.us/maptemplate/languagetracts

[11] In-field observations, and confirmation with representatives of the Watertown Community Development and Planning Department indicate that there are currently 297 rental units under construction (with 30 as affordable) and an additional 282 rental units (with 35 as affordable) proposed – both with frontage and immediate access to Arsenal Street.



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● Historic Site within Study Area

▭ Historic District within Study Area

▬ Arsenal Street Corridor

Arsenal Street Corridor Study | Watertown, Massachusetts

Cultural Resources

Sources: MassGIS, MACRIS

Oil and Hazardous Materials

Based on a review of the Massachusetts Department of Environmental Protection (MassDEP) Bureau of Waste Site Cleanup (BWSC) online database, a total of 118 state-listed disposal sites were identified in the Local Study Area. The presence of a disposal site indicates that a release of oil and/or hazardous materials (OHM) has been reported to MassDEP. The approximate locations (the disposal site is mapped on the portion of the street closest to the geocoded address rather than the actual release location) of the disposal sites are depicted on Figure 2-25A through Figure 2-25D. The results of the OHM review are included in the Appendix.

Regulatory Significance

Potential impacts to the environmental or social constraints associated with this project have regulatory implications. Several regulatory reviews and permits will be needed to allow the project to proceed.

National Environmental Policy Act

If federal funding is likely to be used for the construction of any recommended improvement projects, compliance with the federal National Environmental Policy Act (NEPA) will be required. This will warrant the preparation of a Categorical Exclusion (CE) or an Environmental Assessment (EA). The need for an Environmental Impact Statement (EIS) is not anticipated. Provided the project impacts are found to be acceptable and appropriate and mitigation is provided, a Finding of No Significant Impact (FONSI) will be needed from the lead federal agency to allow the Project to proceed.

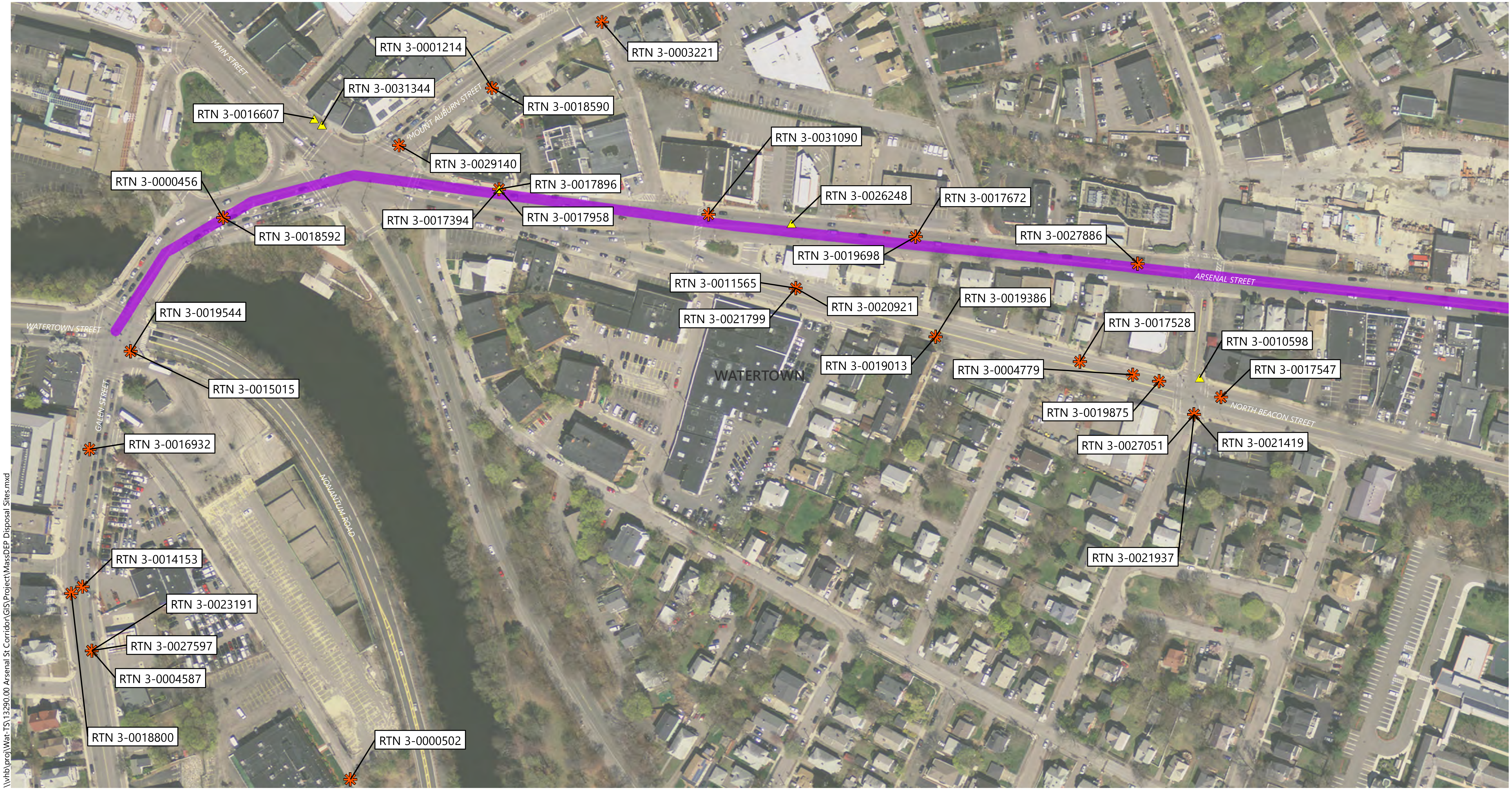
U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers (USACE) regulates alterations to wetlands pursuant to Section 404 of the Clean Water Act and work in navigable waters pursuant to Section 10 of the Rivers and Harbors Act. The Charles River is a federally navigable waterway in Massachusetts. Any construction in the water and adjacent wetlands may require a Section 10/404 permit from the USACE.

Massachusetts Environmental Policy Act

Proposed projects may exceed review thresholds of the Massachusetts Environmental Policy Act (MEPA). Documentation will require the filing of an Environmental

Apr 03, 2017 | **FIGURE 2-25 A**



\\vhb\proj\Wat-TS\13290.00 Arsenal St Corridor\GIS\Project\MassDEP Disposal Sites.mxd

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Legend

- ▬ Approximate Site Location
- ✕ Former NPL Site

MassDEP Disposal Sites

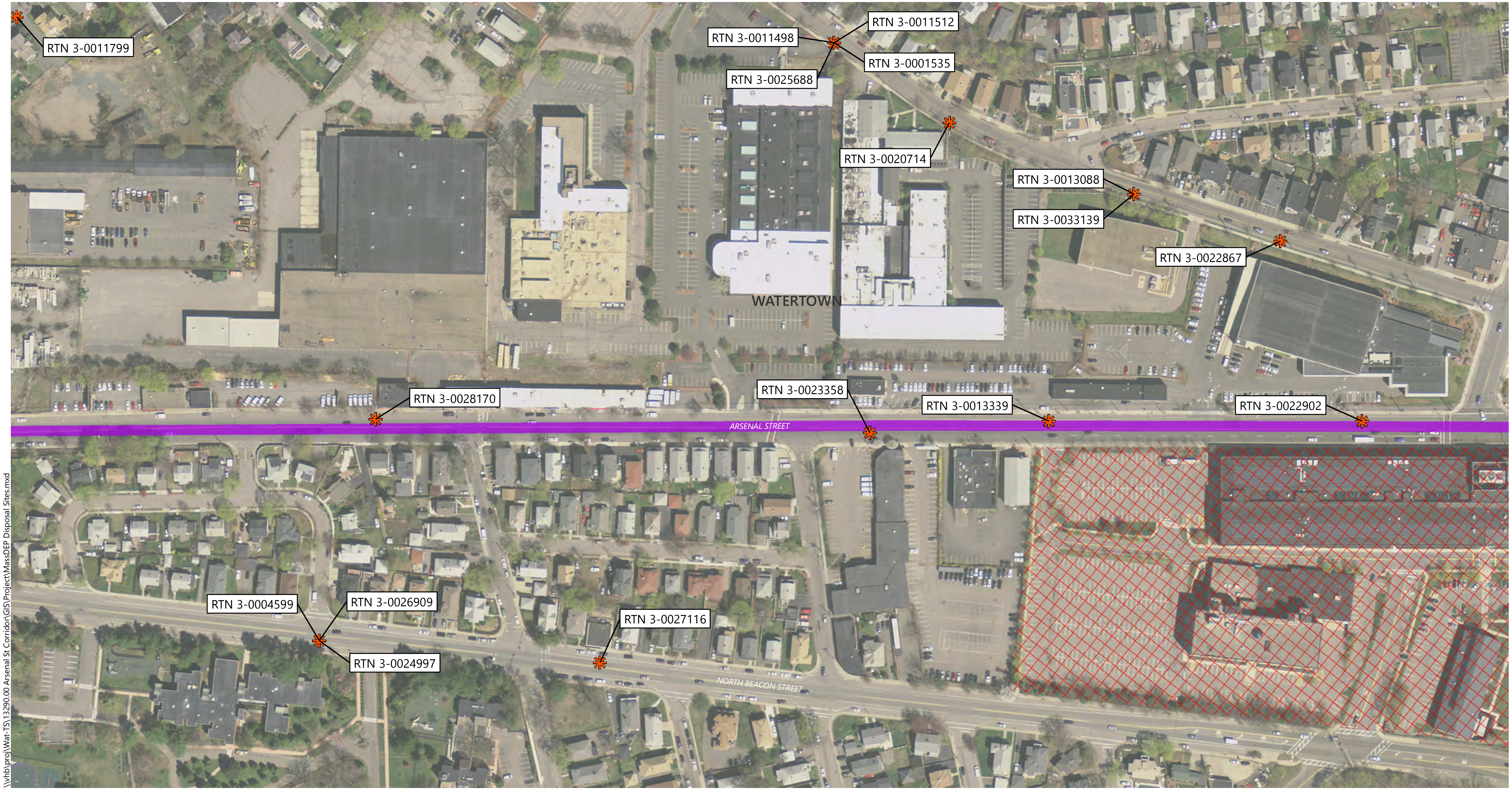
- △ Unlikely to Impact Project
- ✳ Potential to Impact Project

Arsenal Street Corridor Study | Watertown, Massachusetts

MassDEP Disposal Sites

Source: MassGIS 2013 Imagery;
MassDEP Disposal Site Database

Apr 03, 2017 | **FIGURE 2-25 B**



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Legend

- Approximate Site Location
- Former NPL Site

MassDEP Disposal Sites

- △ Unlikely to Impact Project
- ✱ Potential to Impact Project

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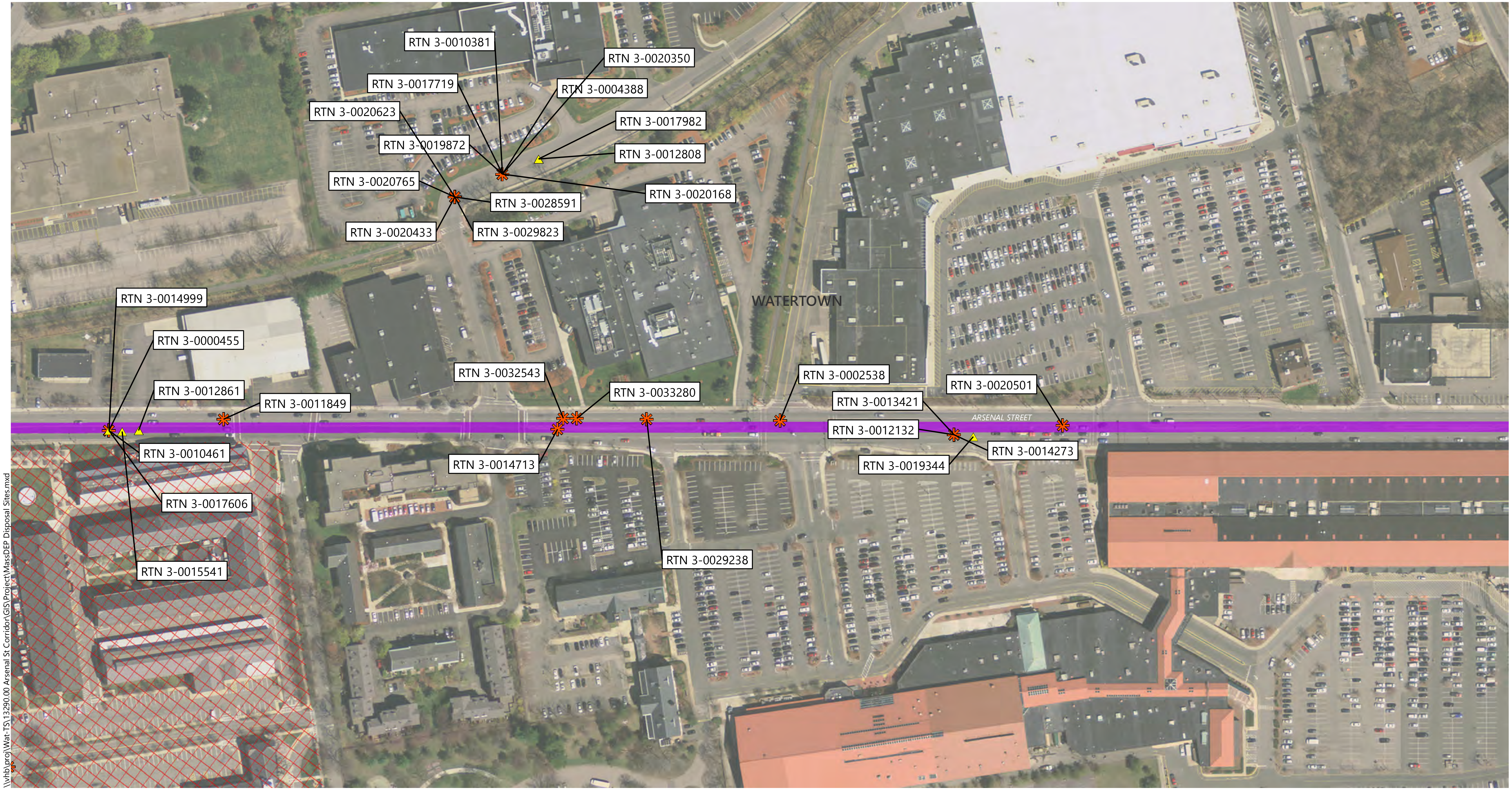
Arsenal Street Corridor Study | Watertown, Massachusetts

MassDEP Disposal Sites

Source: MassGIS 2013 Imagery;
MassDEP Disposal Site Database



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Legend

▬ Approximate Site Location

▨ Former NPL Site

MassDEP Disposal Sites

△ Unlikely to Impact Project

✱ Potential to Impact Project

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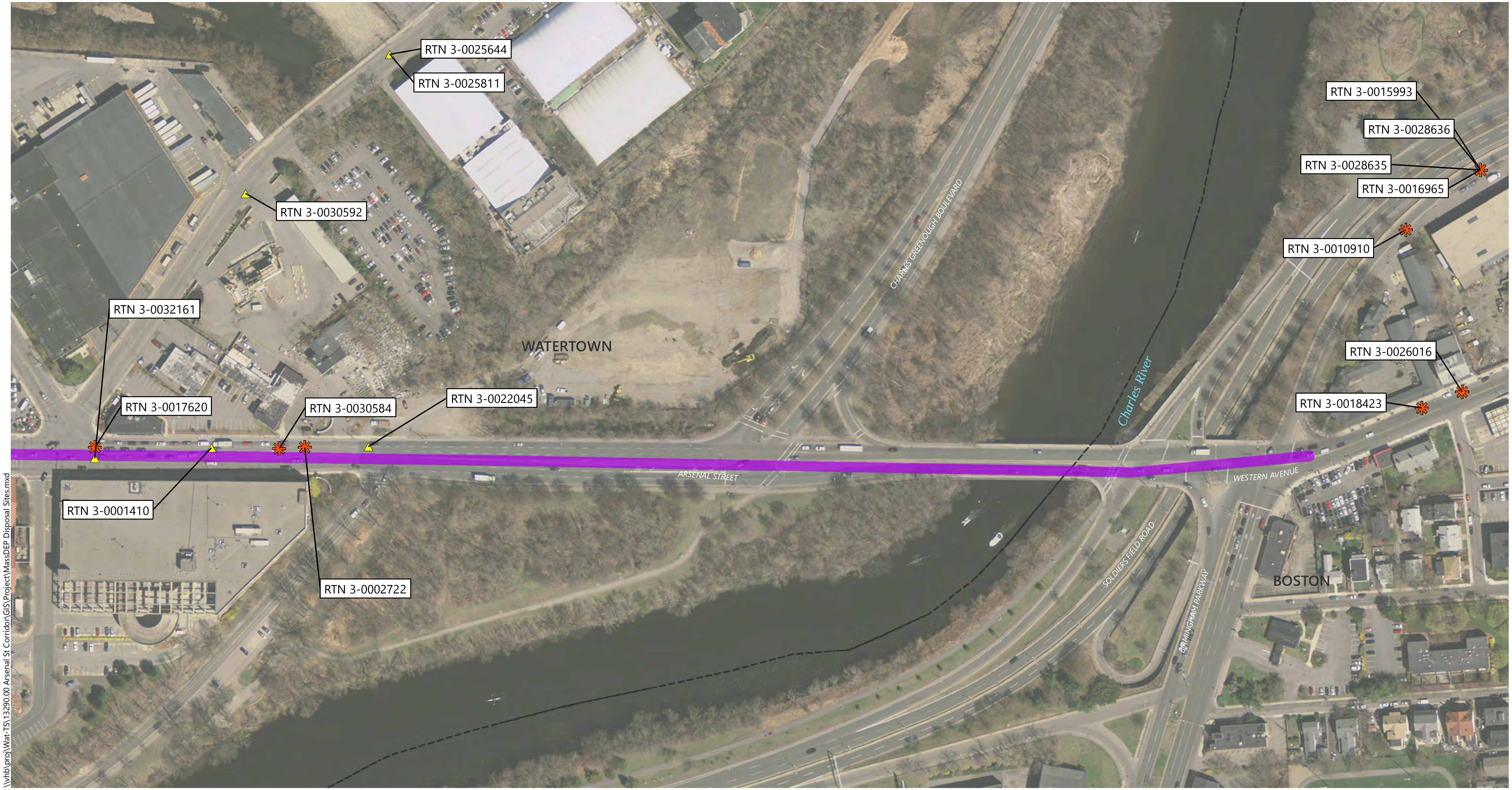
Arsenal Street Corridor Study | Watertown, Massachusetts

MassDEP Disposal Sites

Source: MassGIS 2013 Imagery;
MassDEP Disposal Site Database



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Legend

▬ Approximate Site Location

✕ Former NPL Site

MassDEP Disposal Sites

△ Unlikely to Impact Project

✱ Potential to Impact Project

↑ 0 100 200 400 Feet

Arsenal Street Corridor Study | Watertown, Massachusetts

MassDEP Disposal Sites

Source: MassGIS 2013 Imagery;
MassDEP Disposal Site Database

Notification Form (ENF) with the MEPA Office and may require an Environmental Impact Report (EIR) for review by the Secretary of Energy and Environmental Affairs.

State and Local Wetlands Programs

Wetlands resources are protected by several state and local regulatory programs. Wetland resource areas exist within the vicinity of the Study Area, which are protected by these regulatory programs. These programs include:

- The Massachusetts Wetlands Protection Act (WPA), MGL Chapter 131, Section 40 and its implementing regulations, 310 CMR 10.00;
- Water Quality Certification pursuant to Section 401 of the Clean Water Act (CWA) and its implementing regulations, 314 CMR 9.00;
- Massachusetts Waterways Program (310 CMR 9.00); and
- Watertown Wetlands Ordinance.

Depending on the final improvement recommendations and impacts (if any) to wetland resources, these permitting programs may apply to the Project and will require issuance of permits for construction.

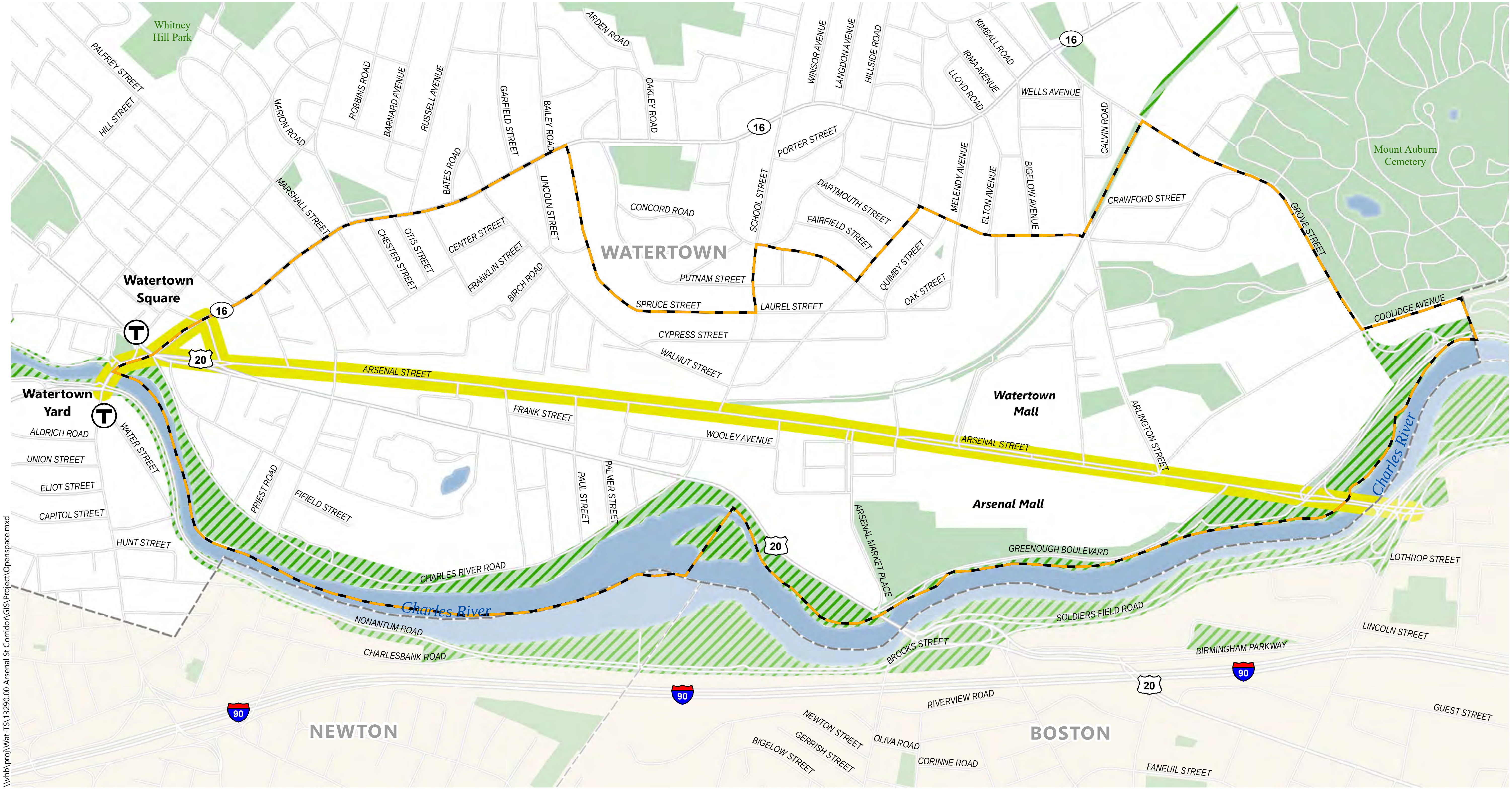
Parkland and Open Space

Article 97 of the State Constitution protects public lands taken for wildlife conservation, open space protection, parks and historic sites and districts. Change of use of these areas requires a 2/3 vote from the state legislature and requires replacement of the area taken. Several parcels of state or local parkland are in the vicinity of the project and any alignment that requires use of these lands will require release through the Article 97 process. Open Space within the project area is depicted on Figure 2-26.

Environmental Justice

As discussed above, a portion of the local study area falls within an Environmental Justice block group, therefore the Executive Order 12898 pertains to this project. Suggested recommendations cannot disproportionally, adversely affect these block group areas and an Environmental Justice screening will be included in the alternatives analysis presented in Chapter 5.

Apr 03, 2017 | **FIGURE 2-26**



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▨ DCR Owned

🟩 Protected and Recreational Open Space

▭ Local Study Area Boundary

🟨 Arsenal Street Corridor

Arsenal Street Corridor Study | Watertown, Massachusetts

Open Space Location Map

Source: MassGIS

Public Health Assessment

The way transportation infrastructure is designed impacts public health and wellbeing in terms of air quality, noise, mobility and connectivity - and hence levels of physical activity, public safety, and land use/economic development.

To analyze existing health conditions along the corridor, available baseline data on child and adult obesity, chronic heart disease, asthma, diabetes and mental health issues (although not directly influenced by transportation) were collected and synthesized to help identify major health concerns. Data was collected from the following public sources:

- Massachusetts Community Health Information Profile (MassCHIP)
- Massachusetts Department of Public Health/Bureau of Environmental Health (BEH) Environmental Public Health Tracking Portal.
- Mount Auburn Hospital 2015 Community Health Needs Assessment Report

Due to limited health information available at the Corridor level, community-wide public health data were used to profile the general health conditions along the Arsenal Street Corridor. While these data do not specifically correlate with transportation issues or opportunities along the corridor, understanding the public health benefits or impacts of transportation options is a key consideration of planning for a successful transportation corridor that serves the needs of all users and the surrounding community.

Baseline Public Health Profile

The Mount Auburn Hospital (MAH) 2015 Community Health Needs Assessment Report analyzed public health needs in seven communities: Watertown, Arlington, Belmont, Cambridge, Lexington, Medford, Somerville and Waltham. According to the report, the top three health concerns affecting the Town of Watertown are obesity and inactive living, poor self-management of chronic diseases, and mental health[12].

Listed below are summaries of the top health concerns identified for Watertown and key statistics comparing Watertown's public health baseline conditions with the State average.

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[12] https://www.mountauburnhospital.org/app/files/public/746/mount-auburn-hospital-community-health-needs-assessment-2015.pdf

1. Obesity and Inactive Living
   - Engaging in a healthy lifestyle is a primary health concern. There is a tie between obesity rate and inactive living and stress, mental health, and chronic disease.
   - Having better places to walk, such as better sidewalks and more green space to walk and exercise, is recognized as a common theme in promoting weight loss and more active living.
   - Watertown (33.4 percent) has a higher rate of overweight or obese students than the state average (31.3 percent)[13].
   - Among neighboring MAH communities[14], Watertown has high quantiles of three years average prevalence of obesity among adults (CY2008-2010) and five years average prevalence of lack of physical activity among adults (CY2001, 2003, 2005, 2007, 2009).
   - When compared to the state average, Watertown has a higher rate of unintentional fall injuries resulting in hospitalizations among older adults age 60 and plus[15].

2. Poor Self-Management of Chronic Disease
   - A lack of understanding of how to manage (and prevent) chronic disease is major concern, including lack of experience dealing with chronic disease, a lack of information about chronic disease and an expectation that chronic disease cannot be managed.
   - The Massachusetts Healthy Aging Data Report reveals that Watertown has several heathy aging indicators that are worse than the state average[16]. Among indicators related to transportation, these include percent of the population ever having a heart attack, with chronic heart disease, and with congestive heart failure.
   - Among other healthy aging indicators, the percentages of adults over 65 with diabetes and asthma are 29.4 percent and 9.4 percent, respectively in Watertown, which are better than the state average of 32.1 and 11.8 percent. These indicators show that to some degree Watertown is better positioned than the state average in baseline public health conditions, particularly for chronic diseases like diabetes and asthma that are known to be more directly impacted by environmental factors.

3. Mental Health Issues
   - The need to address and reduce the stigma, as well as an increase in primary and secondary prevention resources, are considered a priority to address mental health issues. There are close links between mental health and physical health and between mental health and social determents of poverty and homelessness. Also contributing to poor mental health are isolation, a lack of connectives, and a lack of social support.

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[13] http://www.mass.gov/eohhs/docs/dph/com-health/school/status-childhood-obesity-2014.pdf

[14] http://www.mass.gov/eohhs/researcher/community-health/masschip

[15] Ibid

[16] https://mahealthyagingcollaborative.org/data-report/explore-the-profiles

- Watertown has a higher percentage of elders with Alzheimer's disease or related dementias (15.3 percent) than the state (14.4 percent). Watertown (31.6 percent) has a higher percentage of people who reported ever being diagnosed with depression compared to state (28.6 percent)[17].

Built Environment and Public Health

It is well established that community design and the built environment affect human health and wellbeing[18]. According to the U.S. Department of Health and Human Services:

"in its broadest sense, environmental health comprises those aspects of human health, disease, and injury that are determined or influenced by factors in the environment. This includes not only the study of the direct pathological effects of various chemical, physical, and biological agents, but also the effects on health of the broad physical and social environment, which includes housing, urban development, land use and transportation, industry, and agriculture.[19]"

Creating healthy and activity-friendly community environments can improve public heath by:

- Increasing physical activity
- Reducing injury
- Increasing access to healthy food
- Improving air and water quality
- Minimizing the effects of climate change
- Decreasing mental health stresses
- Strengthening the social fabric of a community, and
- Providing fair access to livelihood, education and resources[20].

Different types of improvements or interventions to the built-environment offer varying ranges of public health benefits. Specific to the Arsenal Street Corridor Transportation Study, these could include creating a sustainable transportation system by promoting active transportation options, improving access to open space, parks and trails, and encouraging mixed land use and green urban design.

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[17] http://www.mass.gov/eohhs/researcher/community-health/masschip

[18] Designing Health Communities, Richard Jackson, M.D., 2011

[19] Department of Health and Human Services (US). Healthy People 2010. Volume 1. Washington: DHHS; November 2000.

[20] National Center for Environmental Health. About Healthy Places (2104). Centers for Disease Control and Prevention. Accessed at: http://www.cdc.gov/healthyplaces/about.htm

Creating a Sustainable Transportation System

A sustainable transportation system can include multiple components such as improved public transit services, adequate bicycle and pedestrian accommodations, improved mobility and traffic flow, and traffic calming measures.

- Increasing public transit opportunities helps encourage mode-share along the corridor and reduce auto-dependency. This results in environmental and economic benefits such as enhanced safety, improved air quality and reduced noise level due to less traffic delay, and enhanced retail sales at local stores due to increased pedestrian movements to and from transit nodes.
- Improving pedestrian and bicycle facilities helps promote walking, running and biking which is beneficial to both physical and mental health. More active bicycle and pedestrian circulation also introduces more opportunities for local business and enhances social interactions at the street and neighborhood levels.
- Improving mobility and traffic flow along the corridor promote environmental sustainability and mitigate stress factors affecting mental health by reducing traffic delays and congestion which result in less air pollution, noise, and road safety concerns.

Access to Open Space, Parks, and Trails

One of the derivative community benefits of creating a sustainable transportation system, as described above, is improved connectivity and access to recreational amenities such as open spaces, parks, and walking/biking trails on either side of the corridor.

- Presence, proximity, and accessibility of open space and parks in a community have been shown to have significant public health benefits. Access to parks promotes physical activities and contributes to the prevention and management of obesity and numerous chronic diseases such as heart disease, hypertension, and diabetes. Regular use of parks and green spaces also helps reduce mental stresses.
- Similar to open space and parks, good access to pedestrian and bike trails also help promote physical activity and mental health. It also contributes to safer non-vehicular traveling by providing dedicated travel ways. Improved trail connections also promotes more economic activity through increased pedestrian and bicycle circulation on local streets.

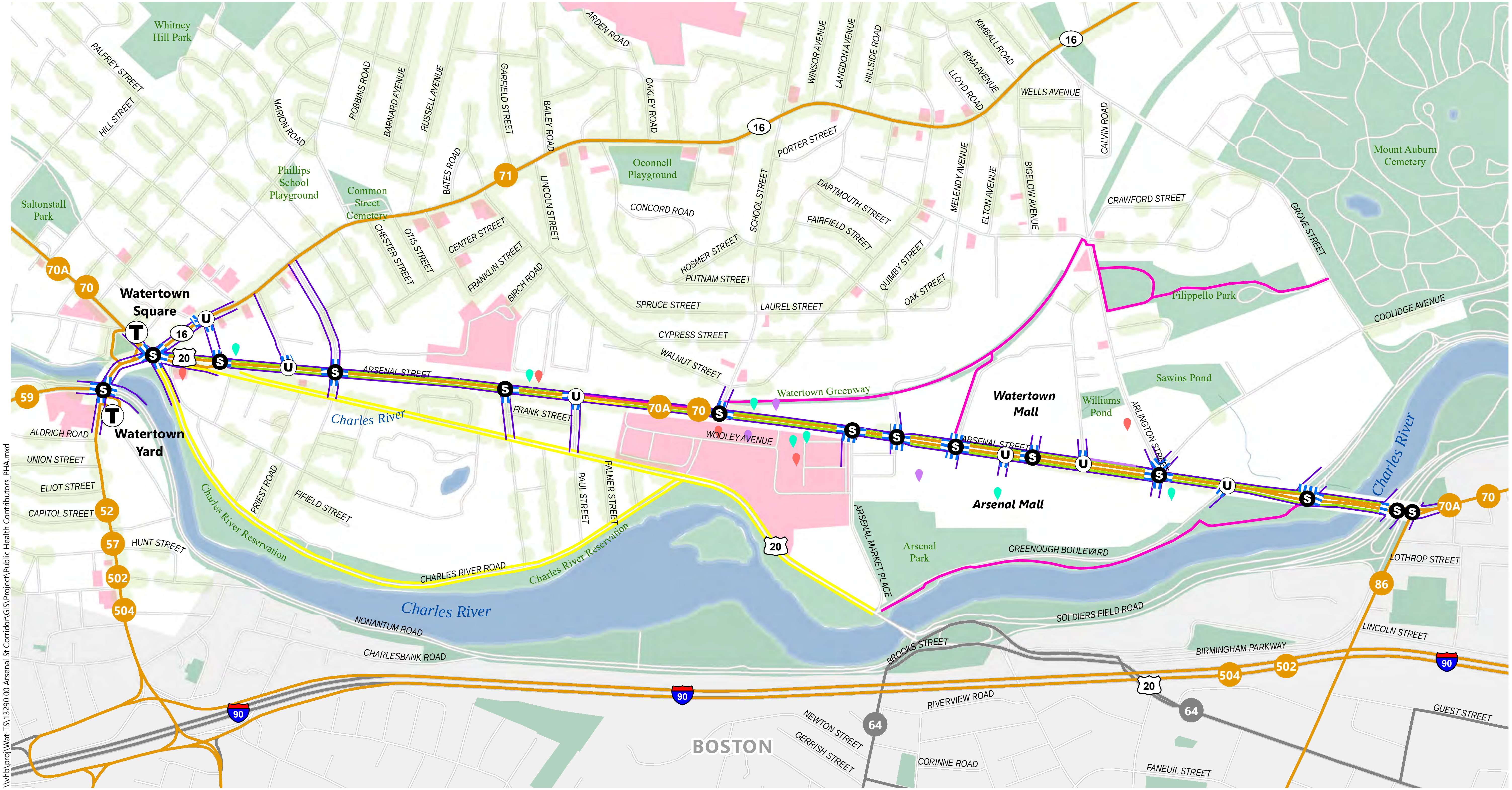
Mixed Land Use and Green Urban Design

Mixed use development can help make people more likely to walk or use transit to run errands, go shopping or go to lunch than does spread-out, automobile-oriented, single use development. Research has found that even a base minimum of physical activity can help combat obesity. People are more likely to walk to destinations such as home, transit, shopping or restaurants if these places are located within a quarter-mile or half-mile of their workplace. These potential land use changes can also improve public health in less direct ways.

- A variety of land uses, building types and public spaces can improve physical and social activity.
- Mixed use development can provide dynamic living, working, and playing environment and active street facades, both of which help encourage street level pedestrian activities and social interaction. Mixed use development can also reduce environmental footprints through more integrated and efficient land use patterns.
- Green urban design and streetscape improvements, which promote walkability and connectivity and provide more greenery and pedestrian amenities, are beneficial to more active and relaxed life styles that are closely related to improved public health.

Public Health Implications of the Study Area Existing Built Environments

Based on the existing conditions analysis presented in this chapter and the relationship between the built environment and public health identified above, the following contributors and barriers to public health have been identified along the Arsenal Street Corridor. These contributors and barriers are illustrated in Figure 2-27 and Figure 2-28 respectively.



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Intersections
- Ⓢ Signalized Study Intersection
- Ⓤ Unsignalized Study Intersection

Transit Route
- # Study Area MBTA Bus Routes
- # Other MBTA Bus/Trackless Trolley Routes

Sidewalks
- Existing Sidewalk
- Sidewalk Under Construction
- Existing Crosswalk

Bike Lanes
- Off-road Bike Lane
- On-road Bike Lane
- Shared Lane Bike Accomodation

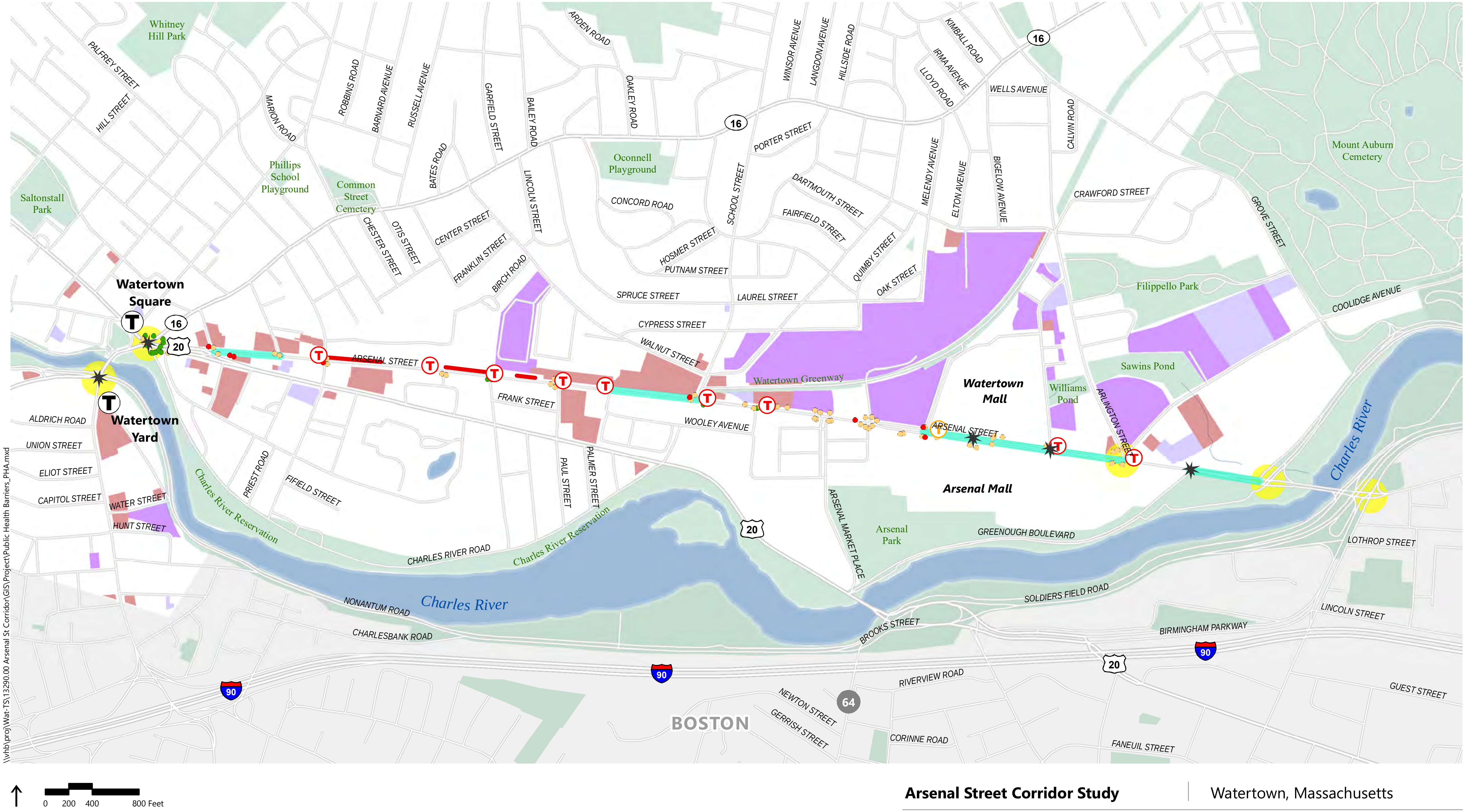
Community Amenities
- Healthy Food Eatery
- Art and Fitness
- Health Care Institution

- 🟩 Parks and Open Spaces
- 🟥 Mixed Use Development
- ● Street Trees

Arsenal Street Corridor Study | Watertown, Massachusetts

Public Health Contributors

Source: MassGIS, Town of Watertown



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Arsenal Street Corridor Study | Watertown, Massachusetts

Bus Stops
- Ⓣ Single Post Bus Stop
- Ⓣ Bus Shelter

— Sidewalk with Deficiencies

Wheelchair Ramp Conditions
- ● Good
- ● Fair
- ● Poor

✶ High Crash Location

▬ High Traffic Volume Section

● *Intersection with More than One Minute Vehicle Delays (Morning Peak Hour)*

Land Uses Unconducive to Public Health
- 🟥 Automotive Sales and Services
- 🟪 Manufacturing and Processing
- ▨ Storage and Distribution Facilities

Public Health Barriers

Source: MassGIS, Town of Watertown

Primary Public Health Contributors

- Access to public transit options:
- Existing bus services provided by the MBTA along the Arsenal Street Corridor (Route 70 and 70A), connect the corridor to neighboring communities and employment destinations in Boston, Cambridge, Dedham, Needham, Newton, Somerville, and Waltham.
- Local bus service within the Study Area also provides connections to MBTA rapid transit and commuter rail.
- Express bus routes provide service between the Study Area and Downtown Boston.
- Access to pedestrian and bicycle facilities:
- Sidewalks are present on both sides of Arsenal Street, with exception of the section just east of Elm Street (under construction as of Fall 2016).
- Bicycle accommodations connecting to and along Arsenal Street include shared lanes, on-road bicycle lanes, off-road bicycle lanes and the Watertown Greenway.
- The majority of the major intersections along the corridor are signalized for traffic control.
- There is currently mixed use development in certain sections of the corridor, with additional mixed use development either planned or under construction.
- There are various parks and playgrounds (Arsenal Park, Filippello Park, etc.) and trails (Watertown Greenway, Charles River Greenway, etc.) on or near either side of the corridor.
- Street trees are present along the Arsenal Street Corridor in various segments, although the coverage has not reached the full length of the corridor due to various setback limitations and curb cuts.
- There are healthy food establishments21, community/cultural facilities and health institutions along the corridor.

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[21] According the CDC, the Dietary Guidelines for Americans, 2010 may be used to develop definition for healthier foods. Generally healthier foods will include fruits, vegetables, whole grains, fat-free and low-fat dairy products, and seafood, as well as foods with less sodium (salt), saturated fats, trans fats, cholesterol, added sugars, and refined grains. Healthier beverages include fat-free or low-fat milk and milk products, fortified soy beverages and other lactose-free products, 100% juice, and water.

Primary Public Health Barriers

- Bus services such as Route 70 and 70A in the Study Area are currently at or over capacity during peak hours.
- There is a lack of bus stop amenities:
- Many of the bus stops located do not have formal shelters and consist of a posted sign along the sidewalk to designate the bus stop.
- In some locations, these bus stops are on narrow sidewalks which provide no additional space for waiting passengers outside the path of pedestrians.
- There are insufficient pedestrian safety features:
- There are uneven sidewalk surfaces in a number of locations along the corridor. In other locations, trees and telephone poles are located in the center of the sidewalk which are an inconvenience to pedestrians.
- There is a general lack of ADA compliant wheelchair ramps along the corridor.
- There are five locations along the corridor where the crash rates exceed the MassDOT District 6 average crash rate, though the majority of other intersections are considered safe or safer than similar intersections. The five locations include Galen Street at Watertown Street/Nonantum Road, Mount Auburn Street/Main Street/Arsenal Street/Charles River Road, Arsenal Street/Arsenal Mall unsignalized driveway, Arsenal Street/Elm Street, and Arsenal Street/Greenough Boulevard (south).
- There is traffic congestion and delay at several intersections along the corridor, including Watertown Square, Arlington Street, and Greenough Boulevard.
- As the primary east-west transportation corridor in Watertown, Arsenal Street carries a large traffic volume on a daily basis. For example, the average daily traffic (ADT) volume on Arsenal Street between Greenough Boulevard (north) and Greenough Boulevard (south) is 23,500 vehicles per day.
- The majority of the land use along the corridor is characterized by low density large format retail, automobile oriented service establishments, and vacant/underutilized parcels. The presence of these land use types creates barriers to a continuous and pleasant pedestrian environment due to numerous curb cuts, large surface parking lots, and general lack of human-scale building facades.

3

Future Conditions, Issues and Opportunities

This chapter provides an assessment of Future Conditions within the study area and the issues and opportunities identified through the data collection and analysis process. The future conditions described in this chapter assume that the transportation improvements currently under construction or programmed have occurred. Programmed improvements include projects programmed on the Transportation Improvement Program (TIP) or currently being initiated by municipalities.

Sections of this chapter present the land use forecasts, planned infrastructure improvements, future traffic demand forecasts, and future traffic operations. Subsequent chapters present the range of alternatives considered, provide an evaluation of these alternatives, and packaged/phased recommendations to address the short, medium, and long-term transportation needs in the study area.

Travel Demand Forecasts

An important component of this study involved forecasting travel demands and land use changes through the year 2040 to ensure that alternatives studied and that the recommended transportation infrastructure investments anticipate future needs and provide long-term benefits for the area. The forecast year is consistent with the Boston Region Metropolitan Planning Organization (MPO)'s Regional Transportation Plan (RTP) and the regional travel demand model (the CTPS model) maintained by the Central Transportation Planning Staff (CTPS) – the technical staff for the Boston Region.

The CTPS model forecasts transit and vehicular conditions in eastern Massachusetts and was used to understand peak period travel demands under the existing conditions and under a future 2040 condition in the Arsenal Street Corridor Study Area. The model is implemented in the EMME/2[22] software package and is based on the four-step transportation planning process of trip generation, trip distribution, mode choice, and trip assignment. The model estimates existing and future transit ridership and highway traffic volumes, primarily on the basis of forecasts of study area demography and projected highway and transit improvements.

In a regional travel demand model, traffic volumes and transit demands are forecasted through the interaction of supply and demand. Traffic Analysis Zones (TAZs) are defined to encompass areas of development that represent the demand. Figure 3-1 represents the TAZ for the project study area. The CTPS model assumes detailed TAZ-level socioeconomic and land use projections to the year 2040 developed by the Metropolitan Area Planning Council (MAPC). Within Watertown, the number of households are projected to increase by 18 percent by 2040. Employment levels are projected to remain comparable to existing conditions with one percent growth projected from 2010 to 2040. However, a conversion of employment from basic (such as manufacturing and warehousing jobs) to service employment (such as office, educational, and health services jobs) is projected.

The road network and transit system represent the supply. The CTPS model includes highway and transit infrastructure projects included on the Boston Region Metropolitan Planning Organization’s Long-Range Transportation Plan (LRTP).

Resulting Forecasts

CTPS supplied estimates from the regional travel demand model for growth in ridership on the Route 70 and 70A buses. Daily ridership is projected to increase by approximately 22 percent between the 2015 base year and the 2040 condition. Approximately 20 percent growth is projected during the weekday morning peak period (6:00 to 9:00 AM) and 16 percent growth is projected during the weekday evening peak period (3:00 to 6:00 PM). The methodology to develop 2040 transit ridership projections for use in this study is discussed in the *Future Transit Conditions* section of this chapter.

CTPS also supplied estimates for traffic volume growth along roadways and at intersections in Watertown. Based on a review of the data, it was determined that town-level data was most appropriate to estimate traffic volume growth within the study area. Approximately six percent growth is projected during the weekday morning peak period (6:00 to 9:00 AM) and four percent growth is projected during the weekday evening peak period (3:00 to 6:00 PM). An average background growth

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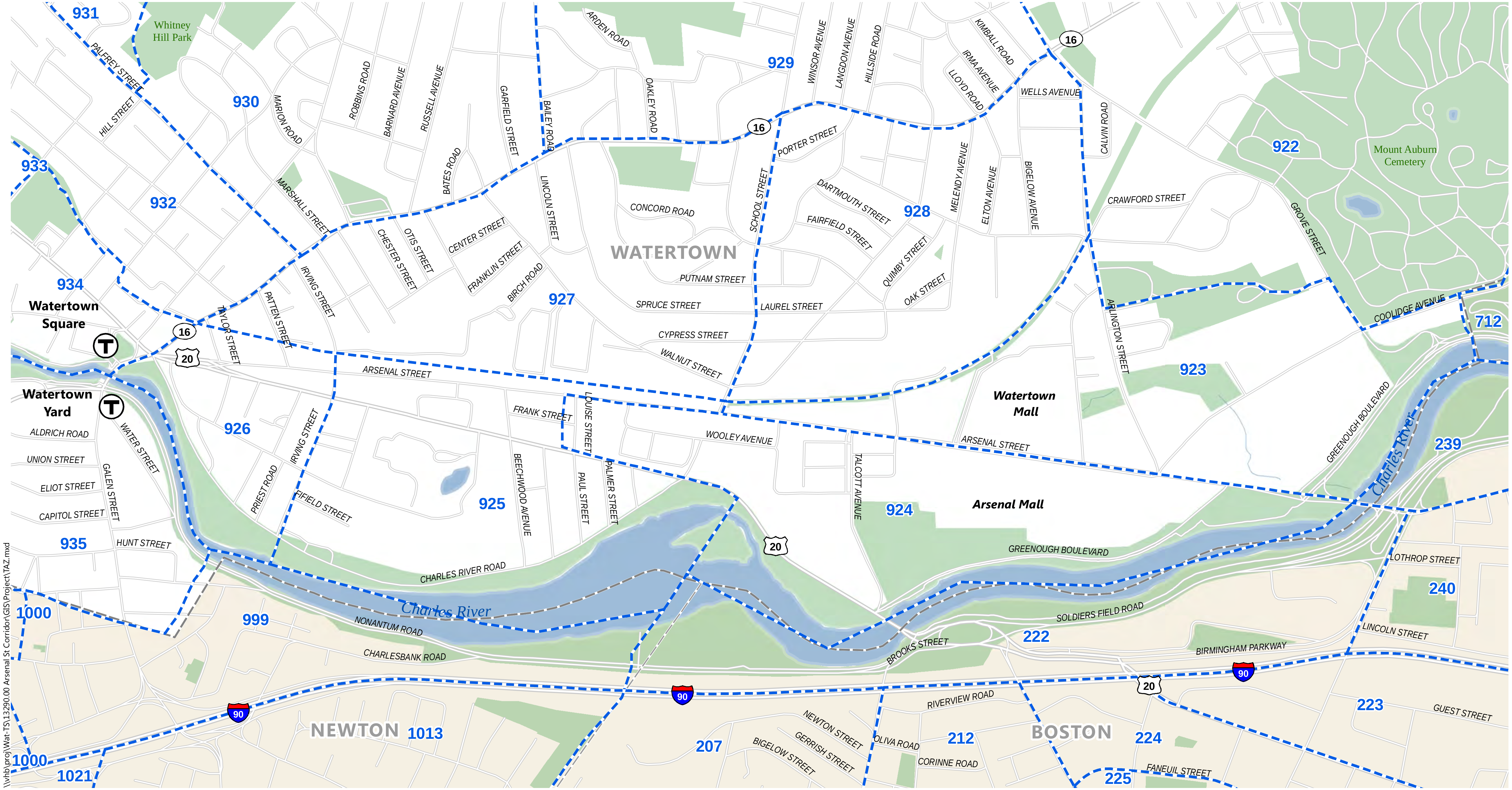
[22] Commercial software package used by CTPS to run their 4-step travel demand model. The software package is used for urban, regional and national transportation forecasting.

Apr 03, 2017 | **FIGURE 3-1**



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Arsenal Street Corridor Study | Watertown, Massachusetts

Traffic Analysis Zone (TAZ)

Traffic Analysis Zone Map

Source: MassGIS

rate of five percent was utilized for both the morning and evening peak hours. The specific methodology to develop 2040 future traffic volumes for the purposes of this study is discussed in the *Future Vehicular Traffic Conditions* section of this chapter.

In addition to growth in transit ridership and traffic demands on facilities within the study area, CTPS also provided growth in trip ends by mode for Watertown TAZs (i.e. trips with an origin or destination within a given TAZ). Growth in transit trip ends for TAZs encompassing the Arsenal Street Corridor Study Area is generally consistent with projections for the entire Route 70 and Route 70A with 17 percent growth in the weekday morning peak period and 11 percent growth in the weekday evening peak period. Growth in vehicle trip ends for the study area TAZs is also comparable to the projected traffic volume growth on Watertown roadways; vehicle trip ends are project to grow by five percent during the weekday morning peak period and three percent during the weekday evening peak period within the study area TAZs. In addition to motorized trips, the CTPS model also projects growth in non-motorized (i.e. walk/bike) trips. Based on the CTPS model output, walk/bike trips are projected to increase by 35 percent during the weekday morning peak period and 28 percent during the weekday evening peak period within the study area TAZs. Non-motorized trips are most likely projected to increase at a higher rate than motorized trips due to the projected future mix of land uses within the study area which will induce shorter trips and provide an opportunity for mode choice.

Future Transit Conditions

The following sections summarize the assumptions, methodology, and results of the transit analysis for 2040 Future Year No Build conditions.

Planned Services

The MBTA Service Planning Department typically reviews the performance and usage of transit services every two years in order to inform recommended service changes. In the absence of any specific changes proposed to the existing services and/or new services currently planned by the MBTA along the Corridor, the 2040 Future Year No Build analysis assumes the existing configuration and characteristics of the Route 70 and 70A bus services along the Arsenal Street Corridor.

Forecasted Ridership

Outputs from the CTPS regional travel demand model include projected transit boardings by route by time period. Projected ridership for the 70 and 70A routes, for each route variant, is summarized in Table 3-1 below for the 2040 Future Year. Due to the availability of more current and robust ridership data from Fall 2015, the Future Year analysis was based on and compared to a 2015 Base Year as opposed to the

2014 existing conditions presented in Chapter 2 of this report. Average weekday ridership is projected to increase by 22 percent on the 70/70A lines between 2015 and 2040, the equivalent of approximately 1,640 additional boardings along the entire route. In the AM Period (6:00 a.m. – 8:59 a.m.), ridership is projected to increase by 20 percent between 2015 and 2040. In the PM Period (3:00 p.m. – 5:59 p.m.), ridership is projected to increase by 16 percent between 2015 and 2040.

Table 3-1 Route 70/70A Projected Ridership (Boardings)

	Base Year (2015)					Future Year Forecasts (2040)				
Route Variant	AM (06:00-08:59)	Midday (09:00-14:59)	PM (15:00-17:59)	Nightime (18:00-05:59)	AWDT	AM (06:00-08:59)	Midday (09:00-14:59)	PM (15:00-17:59)	Nightime (18:00-05:59)	AWDT
70.1 IB (70A) [a]	265	225	0	0	490	306	296	0	0	601
70.1 OB (70A) [b]	0	258	258	42	558	0	326	300	53	680
70.2 OB [c]	0	0	0	6	6	0	0	0	9	9
70.3 IB [d]	0	0	0	50	50	0	0	0	63	63
70.3 OB [d]	209	0	0	0	209	265	0	0	0	265
70.4 IB (70A) [e]	0	109	298	99	507	0	139	337	125	601
70.4 OB (70A) [e]	333	186	0	0	519	417	236	0	0	653
70.5 IB [f]	487	635	404	658	2,184	525	781	488	923	2,717
70.5 OB [f]	506	795	371	523	2,194	653	889	426	674	2,642
70.8 IB [g]	172	0	244	0	416	199	0	276	0	474
70.8 OB [g]	0	134	221	63	418	0	155	255	81	490
Total	1,972	2,341	1,797	1,441	7,551	2,364	2,822	2,082	1,927	9,195
Percent Increase From 2015 Base Year						*19.9%*	*20.5%*	*15.9%*	*33.7%*	*21.8%*

Source: CPTS Ridership Projections for Arsenal Street Corridor Study.

[a] Route serves Smith Street and Trapelo Road in the morning, and Totten Pond Road and Wyman Street in the afternoon and evening.

[b] Route serves Totten Pond Road and Wyman Street in the morning, and Smith Street and Trapelo Road in the afternoon and evening.

[c] Route operates between Central Square in Cambridge and Watertown Square.

[d] Route operates between Waltham Station in Waltham and Green Street at Magazine Street in Cambridge.

[e] Route operates between Lincoln Street at/opposite Silver Hill Lane in Waltham and Central Square in Cambridge.

[f] Route operates between Weston Street at Cedarwood Avenue in Waltham and Central Square in Cambridge.

[g] Route operates between Waltham Station in Waltham and Franklin Street at Sidney Street in Cambridge.

The CTPS 2040 ridership growth projections were compared against historic growth rates, which were determined using MBTA load profile data from Spring 2000 and Fall 2015. Between Spring 2000 and Fall 2015, overall weekday ridership on the Route 70/70A increased by an average of 0.64 percent per year. In comparison, the CTPS ridership forecasts estimate that ridership will increase by an average of 0.79 percent per year between the model base year of 2015 and the future horizon year of 2040. Although the CTPS forecast estimates ridership growth at a slightly higher rate than the historic 15-year average, this higher rate is reasonable given the anticipated development along the 70/70A corridor.

Operations

The impacts to transit operations along the Arsenal Street Corridor resulting from the forecasted growth in transit ridership and forecasted traffic increases (including vehicle loading and service reliability impacts) were analyzed using the following metrics:

- Frequency of individual trips with high/exceeded passenger loading; and
- Impacts (in minutes) to bus run time through the Corridor.

These operational metrics were developed with input from the Study's Working Group.

Vehicle Loading

The MBTA's *Service Delivery Policy* defines the levels of crowding that are acceptable by time period and mode of transportation. For MBTA bus service, the acceptable ratio of passengers to seats during the Early AM, AM Peak, Midday School, and PM Peak periods is 140 percent. For all other periods, the acceptable ratio is 100 percent. For buses along the Arsenal Street Corridor which have a seated capacity of 39 passengers, the maximum acceptable load equals 54 passengers during the peak periods and 39 passengers during off-peak periods.

Vehicle loading in 2040 was determined for an average weekday using CTPS-projected ridership increases along the full length of the 70 and 70A routes. First, the percentage ridership growth was calculated for each time period in the CTPS model (AM Period, Midday Period, PM Period, and Nighttime Period), as summarized previously in Table 3-1. Once growth percentages were established, individual bus trips from Fall 2015 loading data provided by the MBTA, the most current data available at the time of the future conditions analysis, were categorized according to the CTPS model time period definitions, using departure times from the first stop of the route. The CTPS model time period definitions do not correspond directly to the time period definitions outlined in the MBTA's *Service Delivery Policy*. The differences between the CTPS and MBTA time period definitions are outlined in Table 3-2 below for comparison.

Table 3-2 CTPS and MBTA Time Period Definition Comparison

<table>
<tr><td rowspan="2">MBTA Service Delivery Policy Time Periods [HH:MM]</td><td>Early AM</td><td>AM Peak</td><td>Midday Base</td><td>Midday School</td><td>PM Peak</td><td>Evening</td><td>Late Evening</td><td>Night/ Sunrise</td></tr>
<tr><td>06:00-06:59</td><td>07:00-08:59</td><td>09:00-13:29</td><td>13:30-15:59</td><td>16:00-18:29</td><td>18:30-21:59</td><td>22:00-23:59</td><td>00:00-05:59</td></tr>
<tr><td rowspan="2">CTPS Travel Demand Model Time Periods [HH:MM]</td><td colspan="2">AM</td><td colspan="2">MD (Midday)</td><td>PM</td><td colspan="3">NT (Nighttime)</td></tr>
<tr><td colspan="2">06:00-08:59</td><td colspan="2">09:00-14:59</td><td>15:00-17:59</td><td colspan="3">18:00-05:59</td></tr>
</table>

Once individual bus trips were categorized under the CTPS time periods, the projected growth rates by time period were applied uniformly across the entire trip.[23] The result of the calculations described above provides an anticipated passenger load profile for each bus trip under 2040 conditions. The Future Year loads for each trip were then compared to the *Service Delivery Policy* load standard to determine how many trips in each time period are projected to exceed the maximum load standard. For each trip where the load standard was exceeded at one or more locations, the percentage of stops exceeding the standard was calculated to quantify the extent of crowded conditions along the line.

Figures 3-2 and 3-3 illustrate the number of inbound trips and the percentage of stops that exceed the MBTA's *Service Delivery Policy* load standard considering both the entire length of the Route 70/70A and the segment of the Route 70/70A on the Arsenal Street Corridor, respectively. Figures 3-4 and 3-5 illustrate the results for the outbound direction, considering both the entire length of the Route 70/70A and the segment of the Route 70/70A on the Arsenal Street Corridor, respectively.

In both the inbound and outbound directions, more trips are projected to experience overcrowding in 2040 when compared to existing conditions. Under existing conditions, five trips a day experience crowding that exceeds the load standards defined in MBTA's *Service Delivery Policy* somewhere on the Arsenal Street Corridor. By 2040, without improvements the number of trips exceeding the load standard within the Arsenal Street Corridor is expected to increase to 29 trips per day out of 155 total daily trips.

On the Arsenal Street Corridor alone, it is projected that at least one to two inbound trips per time period will experience crowding that exceeds the load standard in the 2040 Future Year. On overloaded inbound trips, the percentage of stops projected to exceed the standard along the Arsenal Street Corridor ranges from 11 percent of stops in the Late Evening Period and Early AM Period to 94 percent of stops in the AM Peak Period and 100 percent of stops in the Night/Sunrise Period (consistent with the observed crowding during the Night/Sunrise Period under existing conditions). In the outbound direction, on the Arsenal Street Corridor alone, it is projected that at least one or more trips will exceed the load standard in all time periods except during the Night/Sunrise and Early AM Periods. On overloaded outbound trips, the percentage of stops projected to exceed the standard along the Arsenal Street Corridor ranges from 20 percent of stops in the Midday Base Period to 100 percent of stops in the Midday School and Late Evening Periods.

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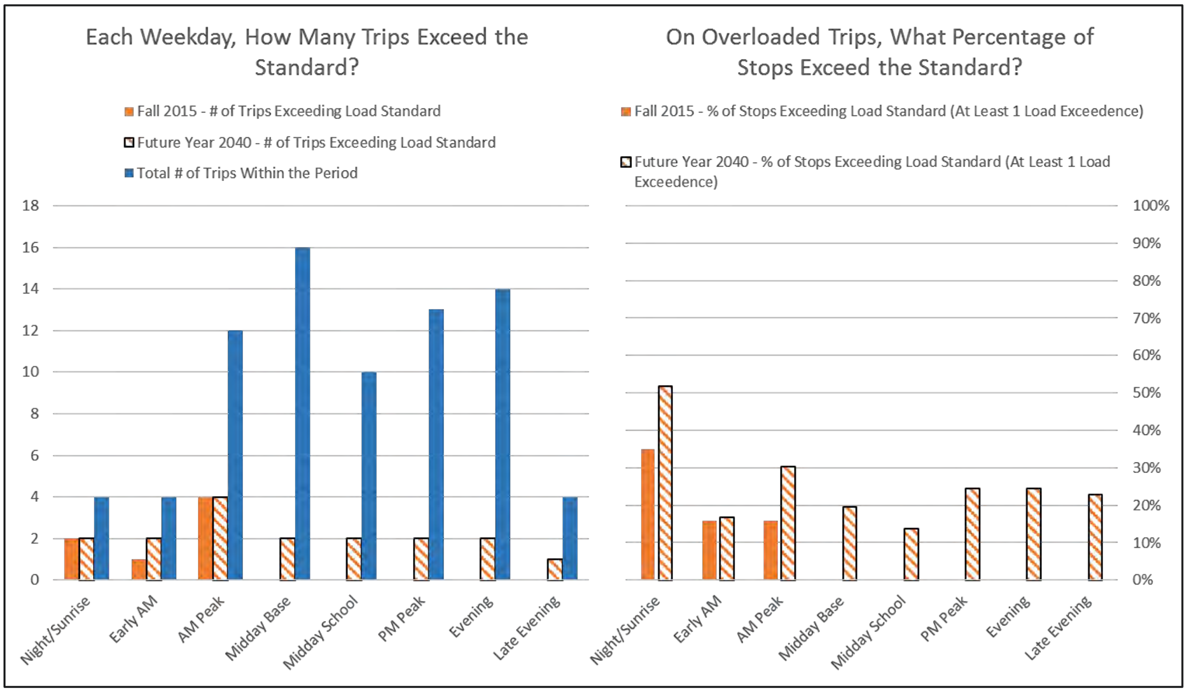
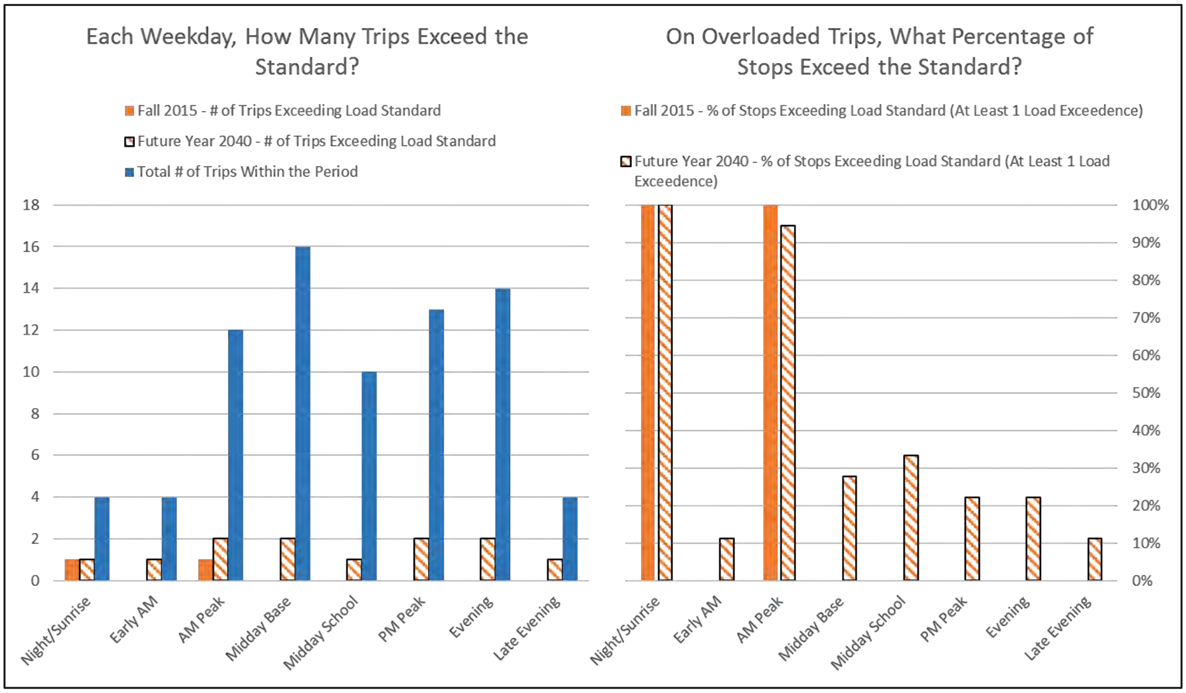
[23] Although it is likely that growth will be concentrated over specific segments of the line, the assumption of uniform growth is reasonable for this level of analysis absent more detailed stop-level ridership projections.

Figure 3-2 Passenger Loading on Entire Route 70/70A – Inbound Direction



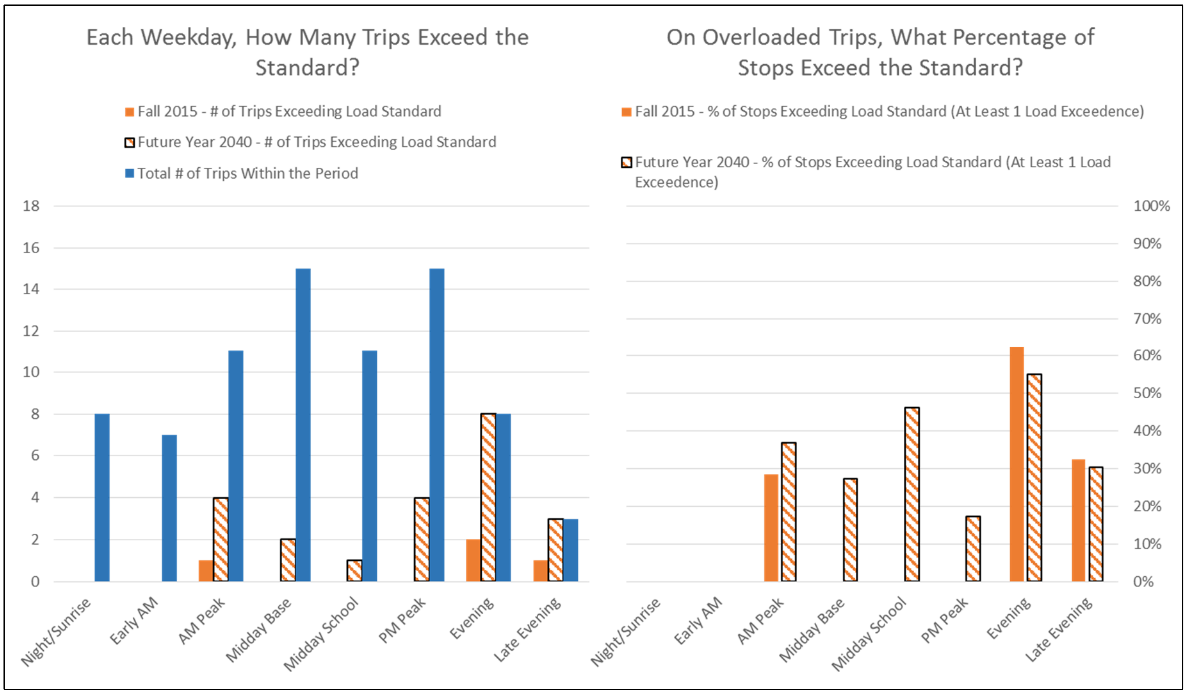
Note: Loading Standard is equal to 54 passengers during peak periods and 39 passengers during off-peak periods.

Figure 3-3 Passenger Loading on Arsenal Street Corridor – Inbound Direction



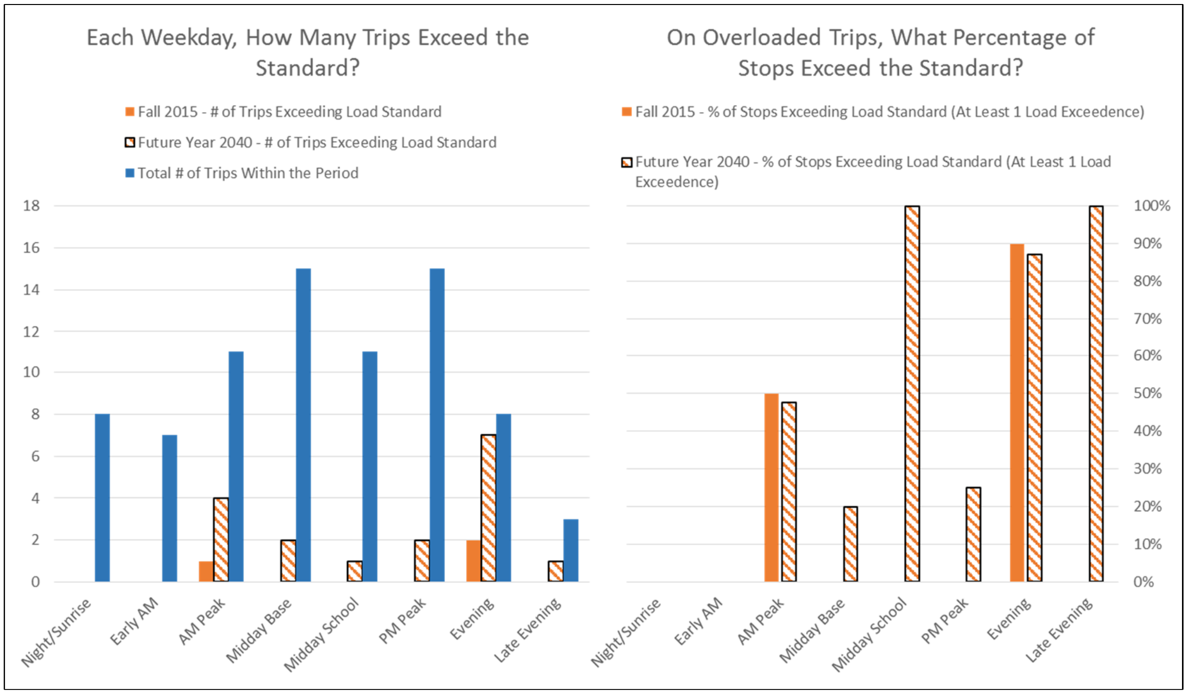
Note: Loading Standard is equal to 54 passengers during peak periods and 39 passengers during off-peak periods.

Figure 3-4 Passenger Loading on Entire Route 70/70A – Outbound Direction



Note: Loading Standard is equal to 54 passengers during peak periods and 39 passengers during off-peak periods.

Figure 3-5 Passenger Loading on Arsenal Street Corridor – Outbound Direction



Note: Loading Standard is equal to 54 passengers during peak periods and 39 passengers during off-peak periods.

Service Reliability

In order to quantify impacts to the anticipated 2040 service reliability, the increase to bus run time (in minutes) through the Corridor was analyzed. The total travel time along the Corridor is a function of both the run time between stops, and the dwell time spent at each stop loading and unloading passengers. Projections for dwell time in the future year will not only depend on changes in ridership, but also on the MBTA's policy for fare collection and validation. Alternative fare payment/validation strategies that would allow for all-door boarding have the potential to significantly decrease dwell times per passenger in the future, and are the subject of a separate MBTA initiative currently underway. As such, this analysis focuses solely on quantifying the potential impacts to corridor run time.

Future run times were simulated using the VISSIM microsimulation model developed for the Local Study Area (see discussion in Chapter 2). The modeled run times were compared with existing conditions data provided by the MBTA in order to find the difference in run time along the Arsenal Street Corridor due to the anticipated increase in traffic under the 2040 No Build condition. Run times from October 2015 were calculated from MBTA-provided data by averaging the observed run times between the Watertown Square and Mackin Street @ Western Avenue timepoints.[24] All buses with a corridor entry or exit time during the AM Peak Hour and PM Peak Hour were counted[25].

A comparison of corridor run times between existing and future year conditions is shown in Table 3-3 and illustrated in Figure 3-6. The magnitude of the increase in corridor run time is projected to range from approximately two additional minutes in the Outbound direction during the AM Peak Hour to approximately 11 additional minutes in the Inbound direction during the PM Peak Hour. The substantial increase in the Inbound PM Peak Hour run time is primarily due to projected traffic congestion at the Watertown Mall/Arsenal Mall vicinity intersections.

Table 3-3 Route 70/70A Projected Run Times

	Base Year (October 2015)		Future Year (2040)	
Analysis Time	Inbound Run Time (Minutes)	Outbound Run Time (Minutes)	Inbound Run Time (Minutes)	Outbound Run Time (Minutes)
AM Peak Hour (8:00 a.m. – 9:00 a.m.)	13.6	11.1	18.6	13.1
PM Peak Hour (5:15 p.m. – 6:15 p.m.)	12.9	14.7	23.9	17.7

Source: MBTA Running Time Reports for October 2015 (provided by MBTA). VISSIM model outputs developed by VHB.

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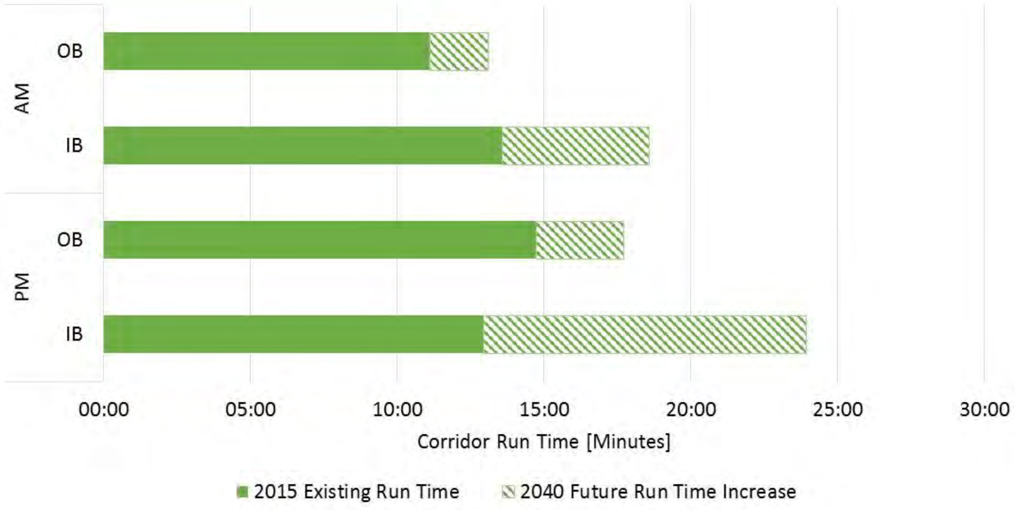
[24] Run times do not include the dwell time spent at intermediate stops.

[25] It should be noted that the VISSIM model is not specifically calibrated to bus operations and that model boundaries vary slightly from the location of the MBTA timepoints that calculate existing run times. This may result in minor discrepancies in projected travel time across the corridor.

Figure 3-6 Projected Run Time Increase Between Watertown Square and Mackin Street at Western Avenue



Future Vehicular Traffic Conditions

The next step in the study process was to evaluate the projected future operations of the study area roadway system and compare them to the existing conditions. The traffic analysis was conducted using 2040 weekday morning and weekday evening peak hour traffic volumes and the future geometric design conditions as they currently are anticipated to exist at or near the study area intersections.

Planned Infrastructure Improvements

The following currently programed infrastructure changes were assumed:

- Narrowing travel lanes between Louise Street and Irving Street to accommodate a two-way multi-use path on the north side of Arsenal Street.
- A two-way multi-use path along the north side of Arsenal Street from School Street to Irving Street.
- Installation of a new traffic signal on Arsenal Street between Beacon Park and Beechwood Avenue.
- Reconstruction of the existing traffic signal at the intersection of Arsenal Street and Beechwood Avenue to include a fourth leg.
- Installation of a new traffic signal at the intersection of Arsenal Street at Wooley Avenue.

- Traffic signal timing optimization throughout the corridor.

Forecasted Traffic Demands

As discussed in the *Travel Demand Forecasts* section of this chapter, output from the CTPS regional travel demand model was used to develop an average background growth rate of five percent for both the morning and evening peak hours. This growth rate accounts for growth in regional traffic volumes to the year 2040.

Given the current level of redevelopment along Arsenal Street corridor, traffic generated by specific planned major developments were also considered. Based on communications with Watertown staff, it was determined that there are five specific projects that have the potential to add traffic to the study area roadways:

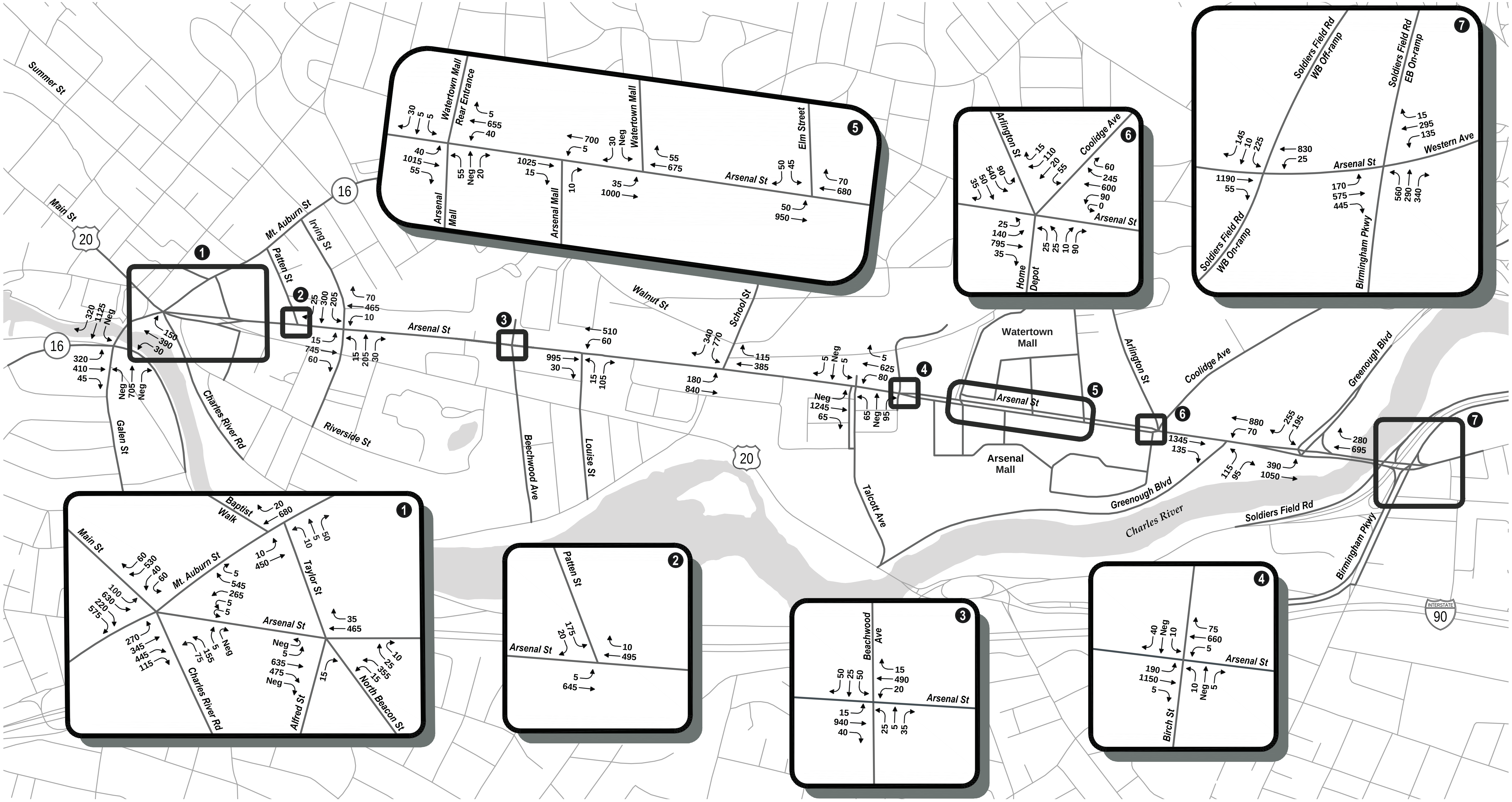
- Marriott Residence Inn Hotel
- The Arsenal on the Charles (athenahealth)
- 480 Arsenal Street (Office Development)
- Hanover Company (Mixed Use Development)
- Elan Union Market

Site-generated traffic volume layers from their respective traffic studies were used. These background project site-generated layers are provided in the Appendix.

The 2040 traffic volumes were developed by applying the five percent growth rate to the 2015 Existing Conditions traffic volumes and adding the traffic volumes associated with the site-specific background projects. Figures 3-7 and 3-8 show the resulting 2040 peak hour traffic volumes.

2040 Traffic Operations

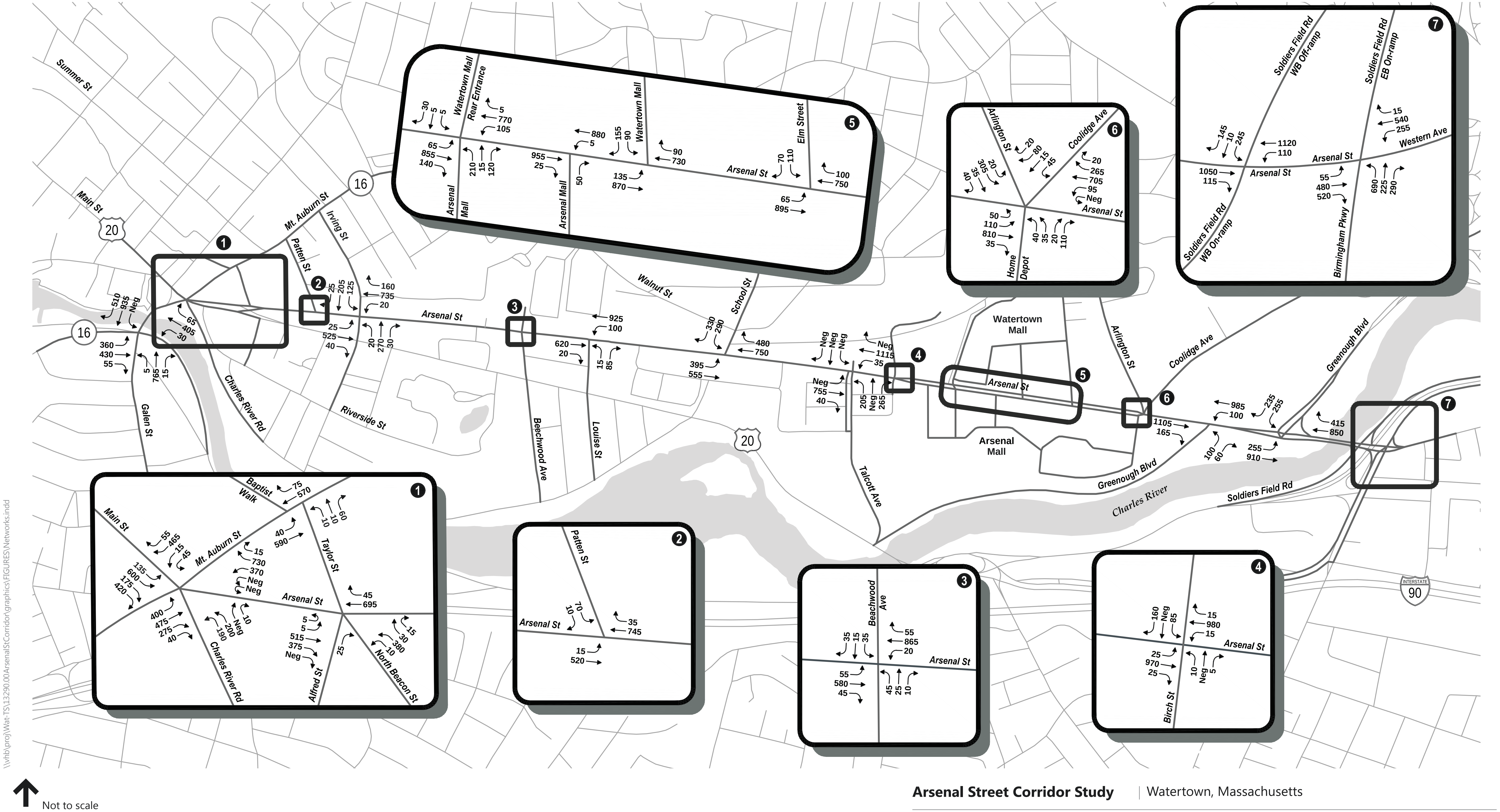
Morning and evening peak hour VISSIM results for the signalized intersections in the study area are presented in Table 3-4 and Table 3-5, respectively. Unsignalized intersection VISSIM results for the morning and evening peak hours are presented in Table 3-6 and Table 3-7, respectively. Figure 3-9 shows the future traffic operations results. All results are included in the Appendix and key results are discussed below.



Arsenal Street Corridor Study | Watertown, Massachusetts

Future Conditions
Weekday Morning Peak Hour
Traffic Volume

Source: MassGIS



Arsenal Street Corridor Study | Watertown, Massachusetts

Future Conditions
Weekday Evening Peak Hour
Traffic Volume

Source: MassGIS

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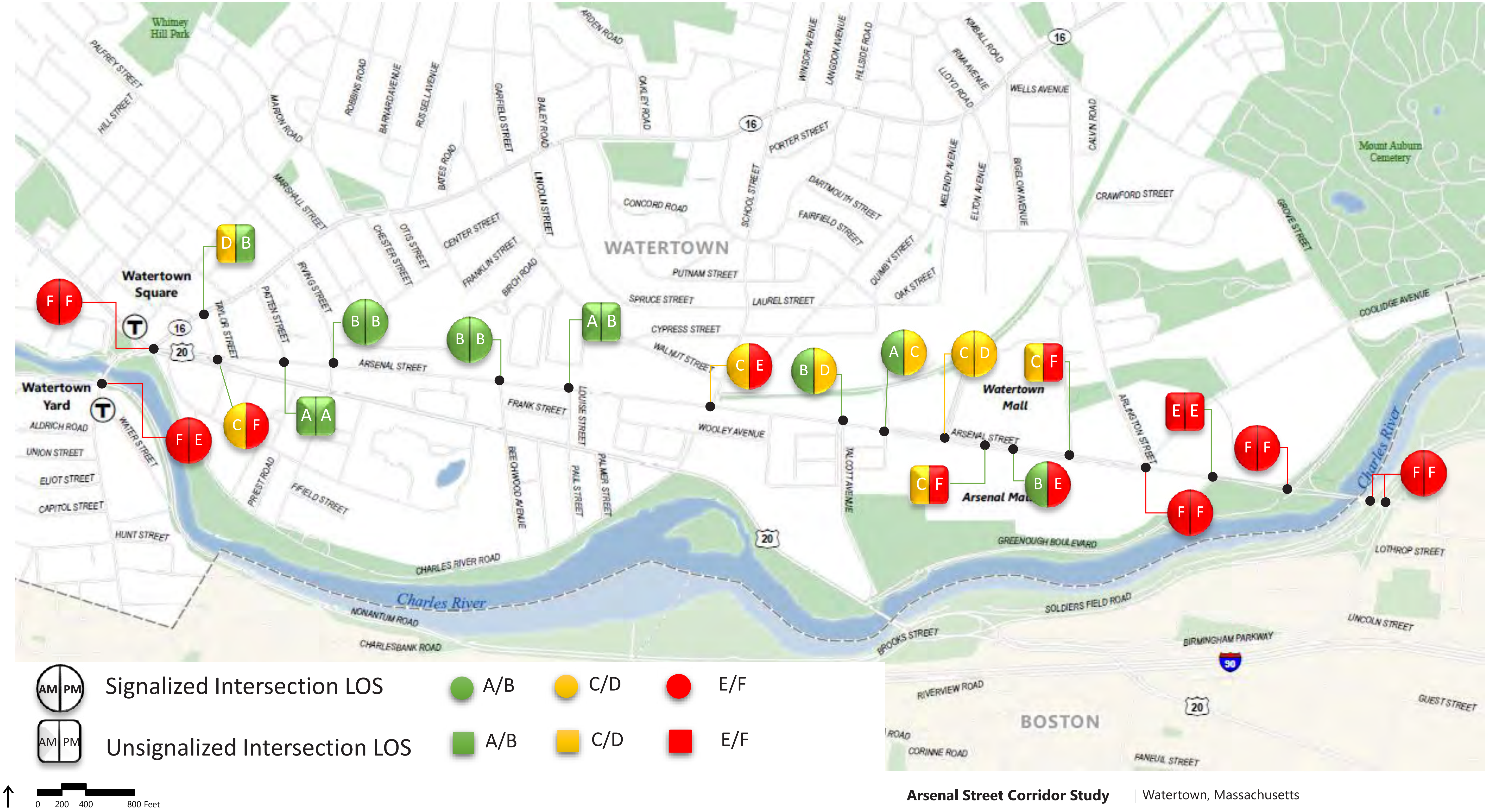


Arsenal Street Corridor Study | Watertown, Massachusetts

Future Traffic Operation Results

Source: MassGIS

Signalized Intersections

All five of the intersections projected to operate at or over capacity in the morning and/or evening peak hours under 2015 conditions would continue to operate poorly under 2040 conditions:

- Galen Street at Watertown Street/Nonantum Road
- Arsenal Street/Main Street at Galen Street/North Beacon Street/Charles River Road/ Mount Auburn Street
- Arsenal Street at Arlington Street/ Coolidge Ave/ Home Depot Driveway
- Arsenal Street at Greenough Boulevard (North)
- Arsenal Street/Western Avenue at Soldiers Field Road/ Birmingham Parkway

It should be noted that two of these intersections operate at LOS E/F during only the morning peak hour in 2015 and are projected to operate at or over capacity during both peak hours in 2040.

Under existing conditions, the morning peak hour was noted to have a higher number of locations with operational deficiencies. Given the types of land uses planned along the corridor, under 2040 conditions it is anticipated that the evening peak hour would experience a higher number of locations with operational issues. In addition to the five intersections discussed above, four additional locations are projected to degrade to LOS E/F during the weekday evening peak hour in the future:

- Arsenal Street at North Beacon Street
- Arsenal Street at School Street
- Arsenal Street at Talcott Street/ Roma Tile Driveway
- Arsenal Street at Birch Street/ Arsenal Court

Unsignalized Intersections

During the morning peak hour, all intersections are projected to continue to operate at overall LOS D or better. Select movements at three intersections are projected to operate at LOS E/F under 2040 future conditions, as shown in Table 3-6.

During the evening peak hour, overall intersection operations at three locations are projected to degrade to LOS E/F:

- North Beacon Street at Alfred Street
- Arsenal Street at Elm Street
- Arsenal Street at Greenough Boulevard (South)

Select movements at one additional intersection are projected to operate at LOS E/F under 2040 future conditions, as shown in Table 3-7.

It should be noted that the VISSIM model used for this analysis considers the impacts of queuing from downstream intersections rather than free flow conditions along the mainline at unsignalized intersections (typically assumed as per HCM methodology). As such, the delay, LOS, and queue results presented may vary from HCM calculations and be slightly overstated.

Table 3-4 Signalized Intersection Capacity Analysis Summary (Morning Peak Hour)

		2015 Existing Conditions				2040 Future Conditions			
Movement		Delay[1]	LOS[2]	Avg Q[3]	Max Q[4]	Delay	LOS	Avg Q	Max Q
Galen Street at Watertown Street/Nonantum Road									
Watertown Street	EB LT	58	E	75	267	84	F	111	380
Watertown Street	EB TH/RT	31	C	75	267	31	C	111	380
Nonantum Road	WB LT-TH/TH-RT	106	F	152	367	>120	F	344	567
Galen Street	NB LT/TH-TH/RT	>120	F	347	864	>120	F	1,245	1,678
Galen Street	SB LT/TH-TH	41	D	146	405	42	D	166	443
Galen Street	SB RT	16	B	18	210	16	B	19	244
	Overall	82	F			>120	F		
Arsenal Street/Main Street at Galen Street/North Beacon Street/Charles River Road/ Mount Auburn Street									
Main Street	EB LT	>120	F	29	149	>120	F	198	445
Main Street	EB TH-TH/RT	>120	F	895	1,486	>120	F	1,366	1,549
Main Street	EB RT	>120	F	919	1,507	>120	F	1,386	1,570
Arsenal Street	WB LT	66	E	85	503	90	F	199	540
Arsenal Street	WB TH/RT	44	D	62	217	48	E	134	390
Charles River Road	NWB LT/TH/RT	54	D	61	293	64	E	84	386
Galen Street	NB LT-LT	40	D	33	236	43	D	28	169
Galen Street	NB TH-TH/RT	102	F	426	542	113	F	472	549
Mount Auburn Street	SB LT	63	E	29	149	58	E	30	160
Mount Auburn Street	SB TH-TH/RT	93	F	203	398	114	F	272	425
	Overall	95	F			106	F		
Arsenal Street at North Beacon Street									
Arsenal Street	EB LT/TH-TH	8	A	15	171	17	B	32	322
Arsenal Street	WB TH-TH/RT	10	A	8	112	16	B	16	173
North Beacon Street	NWB LT/TH-TH	21	C	17	105	53	D	93	793
North Beacon Street	NWB RT	8	A	0	27	19	B	18	190
	Overall	13	B			26	C		
Arsenal Street at Irving Street									
Arsenal Street	EB LT/TH/RT	9	A	13	114	12	B	20	210
Arsenal Street	WB LT/TH/RT	8	A	8	83	9	A	13	156
Irving Street	NB LT/TH/RT	18	B	19	172	36	D	58	173
Irving Street	SB LT/TH/RT	29	C	87	543	26	C	44	211
	Overall	16	B			18	B		
Arsenal Street at Beechwood Avenue									
Arsenal Street	EB LT/TH/RT	2	A	2	84	8	A	19	284
Arsenal Street	WB LT/TH/RT	4	A	3	110	7	A	14	213
Beechwood Avenue	NB LT/TH/RT	20	B	3	66	21	C	6	77
Driveway	SB LT/TH/RT	n/a				47	D	27	139
	Overall	3	A			11	B		

Table 3-4 Signalized Intersection Capacity Analysis Summary (Morning Peak Hour) cont.

		2015 Existing Conditions				2040 Future Conditions			
Movement		Delay[1]	LOS[2]	Avg Q[3]	Max Q[4]	Delay	LOS	Avg Q	Max Q
Arsenal Street at School Street									
Arsenal Street	EB LT	18	B	22	234	20	B	28	246
Arsenal Street	EB TH	13	B	22	234	16	B	28	246
Arsenal Street	WB TH-TH/RT	23	C	26	146	22	C	31	209
School Street	SB LT	25	C	80	363	37	D	167	365
School Street	SB LT/RT	28	C	80	363	39	D	167	365
	Overall	21	C			27	C		
Arsenal Street at Talcott Street/ Roma Tile Driveway									
Arsenal Street	EB LT/TH-TH/RT	17	B	34	198	18	B	45	219
Arsenal Street	WB LT/TH-TH/RT	11	B	16	178	14	B	24	242
Talcott Street	NB LT/TH	14	B	3	65	19	B	5	66
Talcott Street	NB RT	12	B	4	84	15	B	5	94
Roma Tile Driveway	SB LT/TH/RT	0	A	0	0	1	A	0	0
	Overall	15	B			17	B		
Arsenal Street at Birch Street/ Arsenal Court									
Arsenal Street	EB LT/TH-TH/RT	3	A	5	152	4	A	8	182
Arsenal Street	WB LT/TH-TH/RT	6	A	6	137	7	A	11	245
Arsenal Court	NB LT/TH/RT	49	D	3	21	39	D	2	30
Birch Street	SB LT	38	D	2	42	31	C	1	43
Birch Street	SB TH/RT	34	C	3	41	37	D	6	81
	Overall	5	A			6	A		
Arsenal Street at Arsenal Mall/ Watertown Mall (rear) Entrance									
Arsenal Street	EB LT	30	C	5	64	31	C	5	76
Arsenal Street	EB TH-TH	13	B	25	178	15	B	33	281
Arsenal Street	EB RT	12	B	3	61	12	B	3	69
Arsenal Street	WB LT	36	D	7	92	46	D	10	92
Arsenal Street	WB TH-TH/RT	29	C	101	273	30	C	88	358
Arsenal Mall Driveway	NB LT/TH	31	C	9	88	34	C	7	85
Arsenal Mall Driveway	NB RT	19	B	1	68	20	C	1	47
Watertown Mall (Rear Entrance)	SB LT/TH/RT	21	C	3	88	29	C	5	80
	Overall	20	C			22	C		
Arsenal Street at Arsenal Mall/ Watertown Mall									
Arsenal Street	EB LT	8	A	0	0	12	B	0	0
Arsenal Street	EB TH-TH	1	A	1	131	16	B	9	201
Arsenal Street	WB TH-TH	6	A	5	111	6	A	3	139
Arsenal Street	WB RT	4	A	1	45	2	A	0	40
Watertown Mall Driveway	SB LT	0	A	1	42	0	A	3	55
Watertown Mall Driveway	SB RT	17	B	1	42	24	C	3	55
	Overall	3	A			12	B		

Table 3-4 Signalized Intersection Capacity Analysis Summary (Morning Peak Hour) cont.

		2015 Existing Conditions				2040 Future Conditions			
Movement		Delay[1]	LOS[2]	Avg Q[3]	Max Q[4]	Delay	LOS	Avg Q	Max Q
Arsenal Street at Arlington Street/ Coolidge Ave/ Home Depot Driveway									
Arsenal Street	EB LT	63	E	51	327	77	E	56	256
Arsenal Street	EB TH-TH/RT	91	F	83	329	>120	F	307	587
Arsenal Street	WB LT	54	D	25	135	72	E	40	340
Arsenal Street	WB TH-TH/RT	39	D	72	281	45	D	109	679
Home Depot Driveway	NB LT/TH	27	C	21	127	46	D	42	185
Home Depot Driveway	NB RT	86	F	21	127	>120	F	42	185
Coolidge Avenue	SWB LT/TH-TH/RT	56	E	31	157	73	E	37	180
Arlington Street	SEB LT/TH-TH/RT	>120	F	842	1,658	>120	F	1,476	1,674
	Overall	86	F			>120	F		
Arsenal Street at Greenough Boulevard (North)									
Arsenal Street	EB LT	98	F	686	810	100	F	508	808
Arsenal Street	EB TH-TH	>120	F	749	814	>120	F	759	813
Arsenal Street	WB TH-TH	33	C	36	191	42	D	61	389
Arsenal Street	WB RT	1	A	0	0	4	A	0	9
Greenough Boulevard	SB LT-LT/RT	>120	F	23	120	>120	F	35	178
Greenough Boulevard	SB RT	39	D	31	256	44	D	46	378
	Overall	>120	F			>120	F		
Arsenal Street/Western Avenue at Soldiers Field Road/ Birmingham Parkway									
Arsenal Street	EB LT/TH-TH/RT	62	E	587	744	65	E	630	738
Western Avenue	WB LT/TH-TH/RT	80	F	142	462	>120	F	797	1,450
Birmingham Parkway	NB LT-LT	46	D	68	295	54	D	91	351
Birmingham Parkway	NB TH	51	D	84	341	54	D	90	372
Birmingham Parkway	NB RT	56	E	111	379	111	F	289	394
Soldiers Field Road WB Off-Ramp	SB LT/TH	70	E	51	280	54	D	39	223
Soldiers Field Road WB Off-Ramp	SB TH/RT	58	E	24	216	57	E	27	195
	Overall	61	E			81	F		

Source: VHB, Inc. using VISSIM Software

1 – Average Delay, in seconds per vehicle

2 – Level of Service

3 – Average queue length estimate, in feet

4 – Maximum queue length estimate, in feet

EB = Eastbound, WB = Westbound; NB = Northbound; SB = Southbound; NWB= Northwestbound; SEB = Southeastbound; SWB = Southwestbound

LT = Left-turn; TH = Through; RT = Right-turn

Table 3-5 Signalized Intersection Capacity Analysis Summary (Evening Peak Hour)

		2015 Existing Conditions				2040 Future Conditions			
Movement		Delay[1]	LOS[2]	Avg Q[3]	Max Q[4]	Delay	LOS	Avg Q	Max Q
Galen Street at Watertown Street/Nonantum Road									
Watertown Street	EB LT	47	D	84	322	73	E	120	471
Watertown Street	EB TH/RT	36	D	84	322	35	D	120	471
Nonantum Road	WB LT-TH/TH-RT	65	E	72	254	80	F	91	253
Galen Street	NB LT/TH-TH/RT	27	C	55	349	>120	F	604	1,250
Galen Street	SB LT/TH-TH	34	C	98	424	35	D	108	395
Galen Street	SB RT	17	B	41	400	15	B	38	379
	Overall	36	D			72	E		
Arsenal Street/Main Street at Galen Street/North Beacon Street/Charles River Road/ Mount Auburn Street									
Main Street	EB LT	51	D	33	215	83	F	78	559
Main Street	EB TH-TH/RT	53	D	90	408	106	F	381	1,311
Main Street	EB RT	28	C	58	429	68	E	262	1,332
Arsenal Street	WB LT	68	E	140	532	108	F	435	554
Arsenal Street	WB TH/RT	44	D	80	304	59	E	268	533
Charles River Road	NWB LT/TH/RT	55	D	67	390	>120	F	379	470
Galen Street	NB LT-LT	55	E	148	492	71	E	107	444
Galen Street	NB TH-TH/RT	>120	F	380	482	101	F	417	544
Mount Auburn Street	SB LT	46	D	12	84	67	E	21	144
Mount Auburn Street	SB TH-TH/RT	66	E	134	344	90	F	200	409
	Overall	59	E			90	F		
Arsenal Street at North Beacon Street									
Arsenal Street	EB LT/TH-TH	12	B	20	433	50	D	144	50
Arsenal Street	WB TH-TH/RT	12	B	14	142	77	E	182	570
North Beacon Street	NWB LT/TH-TH	43	D	69	848	>120	F	866	926
North Beacon Street	NWB RT	9	A	0	28	>120	F	100	420
	Overall	22	C			82	F		
Arsenal Street at Irving Street									
Arsenal Street	EB LT/TH/RT	10	B	12	137	17	B	70	362
Arsenal Street	WB LT/TH/RT	10	B	17	245	13	B	34	244
Irving Street	NB LT/TH/RT	16	B	22	170	27	C	48	173
Irving Street	SB LT/TH/RT	19	B	22	190	23	C	30	168
	Overall	13	B			18	B		
Arsenal Street at Beechwood Avenue									
Arsenal Street	EB LT/TH/RT	1	A	0	36	9	A	12	201
Arsenal Street	WB LT/TH/RT	2	A	3	131	12	B	42	529
Beechwood Avenue	NB LT/TH/RT	18	B	1	22	24	C	8	89
Driveway	SB LT/TH/RT	n/a				66	E	28	126
	Overall	2	A			14	B		

Table 3-5 Signalized Intersection Capacity Analysis Summary (Evening Peak Hour) cont.

		2015 Existing Conditions				2040 Future Conditions			
Movement		Delay[1]	LOS[2]	Avg Q[3]	Max Q[4]	Delay	LOS	Avg Q	Max Q
Arsenal Street at School Street									
Arsenal Street	EB LT	19	B	25	175	23	C	33	240
Arsenal Street	EB TH	14	B	25	175	15	B	33	240
Arsenal Street	WB TH-TH/RT	25	C	54	246	>120	F	956	1,124
School Street	SB LT	20	C	39	192	22	C	51	335
School Street	SB LT/RT	23	C	39	192	27	C	51	335
	Overall	21	C			74	E		
Arsenal Street at Talcott Street/ Roma Tile Driveway									
Arsenal Street	EB LT/TH-TH/RT	17	B	24	152	16	B	25	221
Arsenal Street	WB LT/TH-TH/RT	13	B	8	83	96	F	265	402
Talcott Street	NB LT/TH	11	B	22	227	>120	F	209	309
Talcott Street	NB RT	13	B	9	105	80	E	102	303
Roma Tile Driveway	SB LT/TH/RT	0	A	0	0	0	A	0	0
	Overall	13	B			71	E		
Arsenal Street at Birch Street/ Arsenal Court									
Arsenal Street	EB LT/TH-TH/RT	3	A	5	164	6	A	11	163
Arsenal Street	WB LT/TH-TH/RT	7	A	12	229	74	E	260	556
Arsenal Court	NB LT/TH/RT	39	D	5	44	46	D	3	43
Birch Street	SB LT	41	D	11	67	>120	F	51	242
Birch Street	SB TH/RT	41	D	13	84	>120	F	213	242
	Overall	8	A			56	E		
Arsenal Street at Arsenal Mall/ Watertown Mall (rear) Entrance									
Arsenal Street	EB LT	36	D	9	85	33	C	9	74
Arsenal Street	EB TH-TH	15	B	22	196	20	B	34	206
Arsenal Street	EB RT	15	B	9	199	16	B	9	138
Arsenal Street	WB LT	40	D	21	159	49	D	24	176
Arsenal Street	WB TH-TH/RT	32	C	111	291	86	F	99	386
Arsenal Mall Driveway	NB LT/TH	33	C	40	236	102	F	69	237
Arsenal Mall Driveway	NB RT	27	C	14	124	41	D	28	203
Watertown Mall (Rear Entrance)	SB LT/TH/RT	30	C	5	60	76	E	7	64
	Overall	25	C			54	D		
Arsenal Street at Arsenal Mall/ Watertown Mall									
Arsenal Street	EB LT	17	B	0	43	29	C	0	44
Arsenal Street	EB TH-TH	5	A	7	196	44	D	34	417
Arsenal Street	WB TH-TH	10	A	9	130	14	B	13	246
Arsenal Street	WB RT	6	A	2	84	7	A	1	82
Watertown Mall Driveway	SB LT	16	B	14	156	59	E	21	145
Watertown Mall Driveway	SB RT	20	B	14	156	26	C	21	145
	Overall	10	A			30	C		

Table 3-5 Signalized Intersection Capacity Analysis Summary (Evening Peak Hour) cont.

		2015 Existing Conditions				2040 Future Conditions			
Movement		Delay[1]	LOS[2]	Avg Q[3]	Max Q[4]	Delay	LOS	Avg Q	Max Q
Arsenal Street at Arlington Street/ Coolidge Ave/ Home Depot Driveway									
Arsenal Street	EB LT	55	D	40	215	>120	F	60	389
Arsenal Street	EB TH-TH/RT	48	D	75	297	>120	F	703	814
Arsenal Street	WB LT	59	E	33	263	69	E	40	393
Arsenal Street	WB TH-TH/RT	44	D	85	346	45	D	108	608
Home Depot Driveway	NB LT/TH	36	D	28	152	98	F	98	233
Home Depot Driveway	NB RT	40	D	28	152	>120	F	98	233
Coolidge Avenue	SWB LT/TH-TH/RT	38	D	17	111	80	F	23	100
Arlington Street	SEB LT/TH-TH/RT	35	C	39	181	>120	F	1,291	1,665
	Overall	44	D			>120	F		
Arsenal Street at Greenough Boulevard (North)									
Arsenal Street	EB LT	53	D	14	205	>120	F	399	806
Arsenal Street	EB TH-TH	>120	F	277	708	>120	F	765	812
Arsenal Street	WB TH-TH	45	D	57	326	55	E	90	531
Arsenal Street	WB RT	3	A	0	0	7	A	5	199
Greenough Boulevard	SB LT-LT/RT	>120	F	53	201	>120	F	71	251
Greenough Boulevard	SB RT	33	C	42	211	43	D	60	326
	Overall	>120	F			>120	F		
Arsenal Street/Western Avenue at Soldiers Field Road/ Birmingham Parkway									
Arsenal Street	EB LT/TH-TH/RT	70	E	684	728	71	E	677	727
Western Avenue	WB LT/TH-TH/RT	>120	F	534	1,172	>120	F	1,265	1,676
Birmingham Parkway	NB LT-LT	51	D	90	340	89	F	202	389
Birmingham Parkway	NB TH	47	D	57	319	49	D	58	304
Birmingham Parkway	NB RT	54	D	84	359	57	E	106	348
Soldiers Field Road WB Off-Ramp	SB LT/TH	73	E	57	341	67	E	50	333
Soldiers Field Road WB Off-Ramp	SB TH/RT	59	E	26	341	60	E	31	333
	Overall	111	F			>120	F		

Source: VHB, Inc. using VISSIM Software
1 – Average Delay, in seconds per vehicle
2 – Level of Service
3 – Average queue length estimate, in feet
4 – Maximum queue length estimate, in feet
EB = Eastbound, WB = Westbound; NB = Northbound; SB = Southbound; NWB= Northwestbound; SEB = Southeastbound; SWB = Southwestbound
LT = Left-turn; TH = Through; RT = Right-turn

Table 3-6 Unsignalized Intersection Capacity Analysis Summary (Morning Peak Hour)

		2015 Existing Conditions				2040 Future Conditions			
Movement		Delay[1]	LOS[2]	Avg Q[3]	Max Q[4]	Delay	LOS	Avg Q	Max Q
North Beacon Street at Alfred Street									
North Beacon Street	EB TH/RT	0	A	0	0	0	A	0	0
North Beacon Street	WB LT/TH	2	A	0	20	14	B	62	695
Alfred Street	NB LT/ RT	6	A	1	57	6	A	1	61
	Overall	5	A			10	B		
Mount Auburn Street at Taylor Street									
Mount Auburn Street	EB LT/TH-TH	1	A	0	48	1	A	0	28
Mount Auburn Street	WB TH-TH/RT	6	A	11	184	40	E	107	500
Taylor Street	NB LT/TH/RT	11	B	1	48	15	B	2	69
	Overall	4	A			26	D		
Arsenal Street at Patten Street									
Arsenal Street	EB LT/TH	1	A	0	47	2	A	5	62
Arsenal Street	WB TH/RT	0	A	0	0	1	A	0	0
Patten Street	SB LT/RT	14	B	9	97	20	C	19	197
	Overall	3	A			5	A		
Arsenal Street at Louise Street									
Arsenal Street	EB TH/RT	1	A	1	101	2	A	2	2
Arsenal Street	WB LT/TH	9	A	40	202	3	A	3	211
Louise Street	NB LT/RT	25	C	4	76	16	C	6	92
	Overall	6	A			3	A		
Arsenal Street at Arsenal Mall/ Watertown Mall									
Arsenal Street	EB RT	0	A	0	0	0	A	0	0
Arsenal Mall Driveway	NB RT	9	A	0	24	27	D	0	36
	Overall	-	-			-	-		
Arsenal Street at Elm Street									
Arsenal Street	EB LT	0	A	0	0	6	A	1	54
Arsenal Street	EB TH-TH	1	A	0	0	29	D	29	87
Arsenal Street	WB TH-TH/RT	0	A	0	0	1	A	1	85
Elm Street	SB LT/RT	10	A	2	48	>120	F	43	142
	Overall	1	A			22	C		
Arsenal Street at Greenough Boulevard (South)									
Arsenal Street	EB TH-TH/RT	84	F	353	660	92	F	504	670
Arsenal Street	WB LT/TH-TH	5	A	11	165	8	A	14	338
Greenough Boulevard	NB LT/RT	34	D	26	186	43	E	44	261
	Overall	53	D			54	D		

Source: VHB, Inc. using VISSIM Software
1 – Average Delay, in seconds per vehicle
2 – Level of Service
3 – Average queue length estimate, in feet
4 – Maximum queue length estimate, in feet
EB = Eastbound, WB = Westbound; NB = Northbound; SB = Southbound;
LT = Left-turn; TH = Through; RT = Right-turn

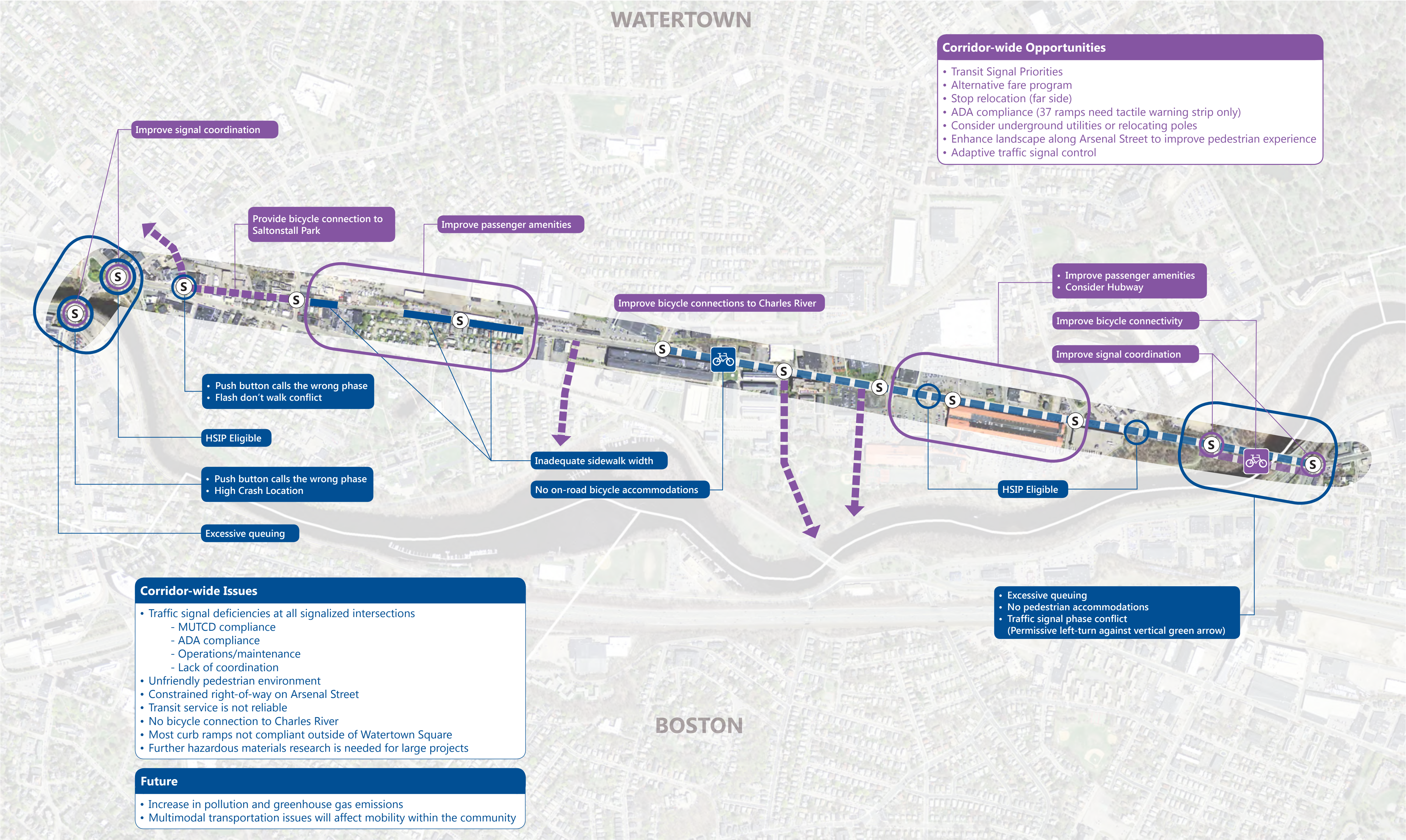
Table 3-7 Unsignalized Intersection Capacity Analysis Summary (Evening Peak Hour)

		2015 Existing Conditions				2040 Future Conditions			
Movement		Delay[1]	LOS[2]	Avg Q[3]	Max Q[4]	Delay	LOS	Avg Q	Max Q
North Beacon Street at Alfred Street									
North Beacon Street	EB TH/RT	0	A	0	0	0	A	0	0
North Beacon Street	WB LT/TH	8	A	44	764	>120	F	782	842
Alfred Street	NB LT/ RT	10	A	1	54	10	A	1	64
	Overall	9	A			41	E		
Mount Auburn Street at Taylor Street									
Mount Auburn Street	EB LT/TH-TH	1	A	0	76	1	A	0	22
Mount Auburn Street	WB TH-TH/RT	1	A	0	73	21	C	51	340
Taylor Street	NB LT/TH/RT	11	B	1	50	24	C	8	191
	Overall	1	A			13	B		
Arsenal Street at Patten Street									
Arsenal Street	EB LT/TH	1	A	5	71	6	A	55	374
Arsenal Street	WB TH/RT	0	A	0	0	7	A	8	208
Patten Street	SB LT/RT	11	B	3	65	16	C	19	182
	Overall	1	A			7	A		
Arsenal Street at Louise Street									
Arsenal Street	EB TH/RT	1	A	0	64	8	A	1	147
Arsenal Street	WB LT/TH	6	A	18	126	19	C	39	621
Louise Street	NB LT/RT	10	A	3	54	14	B	4	75
	Overall	4	A			15	B		
Arsenal Street at Arsenal Mall/ Watertown Mall									
Arsenal Street	EB RT	0	A	0	0	1	A	0	9
Arsenal Mall Driveway	NB RT	15	B	1	47	45	E	1	55
	Overall	-	-			-	-		
Arsenal Street at Elm Street									
Arsenal Street	EB LT	3	A	0	47	11	B	0	48
Arsenal Street	EB TH-TH	0	A	0	0	127	F	87	279
Arsenal Street	WB TH-TH/RT	1	A	0	91	3	A	3	271
Elm Street	SB LT/RT	11	B	5	99	>120	F	236	253
	Overall	2	A			88	F		
Arsenal Street at Greenough Boulevard (South)									
Arsenal Street	EB TH-TH/RT	4	A	0	72	110	F	542	651
Arsenal Street	WB LT/TH-TH	5	A	3	236	11	B	27	396
Greenough Boulevard	NB LT/RT	15	B	8	119	32	D	22	162
	Overall	5	A			61	E		

Source: VHB, Inc. using VISSIM Software
1 – Average Delay, in seconds per vehicle
2 – Level of Service
3 – Average queue length estimate, in feet
4 – Maximum queue length estimate, in feet
EB = Eastbound, WB = Westbound; NB = Northbound; SB = Southbound;
LT = Left-turn; TH = Through; RT = Right-turn

Issues, Opportunities, and Constraints

The framing of study area transportation issues, opportunities, and constraints evolved from a thorough review of data and the compilation of concerns and desired outcomes identified through the public outreach process. Table 3-8 and Figure 3-10 organize and present these issues, opportunities, and constraints. A more detailed discussion is provided in the Appendix.



Improve signal coordination

Provide bicycle connection to Saltonstall Park

Improve passenger amenities

Improve bicycle connections to Charles River

- Improve passenger amenities
- Consider Hubway

Improve bicycle connectivity

Improve signal coordination

- Push button calls the wrong phase
- Flash don't walk conflict

HSIP Eligible

- Push button calls the wrong phase
- High Crash Location

Excessive queuing

Inadequate sidewalk width

No on-road bicycle accommodations

HSIP Eligible

- Excessive queuing
- No pedestrian accommodations
- Traffic signal phase conflict (Permissive left-turn against vertical green arrow)

Corridor-wide Opportunities

- Transit Signal Priorities
- Alternative fare program
- Stop relocation (far side)
- ADA compliance (37 ramps need tactile warning strip only)
- Consider underground utilities or relocating poles
- Enhance landscape along Arsenal Street to improve pedestrian experience
- Adaptive traffic signal control

Corridor-wide Issues

- Traffic signal deficiencies at all signalized intersections
  - MUTCD compliance
  - ADA compliance
  - Operations/maintenance
  - Lack of coordination
- Unfriendly pedestrian environment
- Constrained right-of-way on Arsenal Street
- Transit service is not reliable
- No bicycle connection to Charles River
- Most curb ramps not compliant outside of Watertown Square
- Further hazardous materials research is needed for large projects

Future

- Increase in pollution and greenhouse gas emissions
- Multimodal transportation issues will affect mobility within the community

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Arsenal Street Corridor Study | Watertown, Massachusetts

Issues, Opportunities, and Constraints

Source: MassGIS, CTPS Regional Travel Demand Model

Table 3-8 Study Areas Issues, Opportunities, and Constraints

		Issues	Opportunities	Constraints
Transit	Transit Capacity and Reliability The current transit system fails to provide reliable and consistent service along the Arsenal Street corridor. Additionally, an increased reliance on transit, both today and in the future, taxes a regional system that is nearing capacity.	• Crowding on buses results in uncomfortable conditions or a potential missed trip for MBTA passengers. • Bus services along the corridor are scheduled services (as opposed to high-frequency walk-up service), but do not operate with high reliability. • Bus schedules along the corridor consist of uneven service headways.	• Implement Route 70/70A service modifications to support improved reliability. • Implement Transit Signal Priority (TSP) along the Study Corridor. • Consider alternative fare payment/validation strategies that allow for all-door boarding.	• Fleet and support facility constraints limit the ability to increase peak period service on the corridor.
	Transit Amenities Existing amenities along the Arsenal Street Corridor detract from a high-quality experience for transit riders.	• Limited transit passenger facilities exist on the Arsenal Street Corridor.	• Add passenger amenities to corridor stops.	• The limited right-of-way along the Arsenal Street Corridor presents a physical constraint to potential transit stop improvements.
Vehicle	Capacity Constraints at Corridor Gateways The Watertown Square and Soldiers Field Road intersections serve as gateways to the Arsenal Street corridor from the regional transportation network. These locations are at or nearing capacity during both peak hours today and are limited by the capacity of the Charles River crossings.	• The Watertown Square and Soldiers Field Road gateways are constrained.	• Improve operations at the Watertown Square gateway. • Improve operations at the Soldiers Field Road gateway.	• Limited right-of-way presents a physical constraint to potential gateway improvements. • Capacity is limited by the Charles River crossings at both the east and west gateways.
	Vehicular Operations and Progression As development potential along the corridor and in the region is realized, intersection capacity along Arsenal Street will be constrained during both peak hours at many locations.	• Vehicle operations along the corridor will be constrained at many locations in the future. • Traffic progression along the Arsenal Street corridor is poor. • During inventories of the traffic signal equipment, issues were noted at all 14 existing signalized intersections.	• Investigate the feasibility of coordinating Arsenal Street signals, potentially with a fully Adaptive Signal Control (ASC) system. • Incrementally improve signals to address non-compliance issues.	• High level of traffic signalization along the corridor requires careful coordination and maintenance of traffic signal equipment. • Balancing multimodal transportation needs in a constrained corridor limits the ability to make wholesale operational changes.
Bicycle	Bicycle Connectivity Completing the Arsenal Street bicycle network and providing connections between the corridor and the region's expanding bicycle network will facilitate both through trips and those with destinations along the corridor.	• Gaps in bicycle network east of School Street limit mobility. • Connections between Arsenal Street and the regional bicycle network are limited.	• Complete the Arsenal Street bicycle network. • Provide bicycle connections between Arsenal Street and points west. • Connect Arsenal Street to the Charles River. • Continue bicycle accommodations to Western Avenue. • Investigate the feasibility of expanding Hubway into Watertown.	• Limited right-of-way presents a physical constraint to providing bicycle accommodations. • Constrained right-of-way and heavy vehicular traffic in Watertown Square and at the Soldiers Field Road gateways. • Property between Arsenal Street and the Charles River are privately owned.
	Bicycle Amenities Improving amenities along the corridor will encourage and support bicycle travel.	• A lack of amenities within the corridor discourage bicycle travel.	• Incorporate improved bicycle amenities into development mitigation commitments.	• Mitigation for many of the developments along Arsenal Street has already been approved.
Pedestrian	Pedestrian Mobility Significant growth is anticipated in walk trips as the corridor transitions to a live-work-play district. While sidewalks are provided throughout, the general quality of the pedestrian network along Arsenal Street is inconsistent, impacted by construction activity and obstructed by physical barriers in some locations.	• The existing pedestrian environment is inconsistent and unfriendly in locations. • Most curb ramps outside of Watertown Square at not compliant with current standards. • Construction activities impact pedestrian mobility.	• Work with developers along Arsenal Street to improve pedestrian accommodations and maintain mobility during construction activities. • Address non-compliant curb ramps.	• Limited right-of-way presents a physical constraint to widening the sidewalk in many locations. • Guidance on accessibility is frequently updated, making it difficult to plan for, construct, and maintain a fully accessible corridor. • Mitigation for many of the developments along Arsenal Street has already been approved.
Safety	Address Safety Deficiencies There are a series of noted safety deficiencies at study area intersections. Many locations are eligible for FHWA and MassDOT funds to improve identified safety issues.	• The intersection of Galen Street at Nonantum Road/ Watertown Street is ranked 178 in the 2011-2013 Statewide Top 200 Intersection Crash List. • There are several HSIP-eligible intersection clusters within the study area. • Out of the 20 study area intersections, five locations have crash rates that exceed the District 6 average crash rate. • A review of traffic signal equipment throughout the corridor identified three locations where small changes to location or equipment are necessary.	• Through MassDOT, all HSIP candidate locations require a Road Safety Audit (RSA). • Address safety deficiencies through other planned or future improvement projects.	• Achieving consensus and implementing improvement strategies at multiple locations in a timely manner.

4

Alternatives Development and Screening

The analysis of existing and future transportation conditions and development of issues, opportunities and constraints in the study area identified areas of the transportation network that require improvements. A range of transportation improvements were identified through Working Group guidance and extensive public outreach throughout the study.

This chapter describes the alternatives that were identified as having the potential to address the transportation system issues and deficiencies and meet the goals and objectives of this study. This preliminary screening evaluation is the equivalent of a "fatal flaw" assessment that helped to discard recommendations that are either outside the scope of this study, do not address the goals or objectives, or deemed to be not realistic or feasible. Chapter 5 will present an evaluation of the screened alternatives from this chapter.

Alternatives Grouping and Methodology

From the outset of the study, ideas for transportation system improvements were solicited from the public, stakeholders, and the Working Group. These ideas were developed and vetted into a series of alternatives to be screened by the Study Team and the Working Group. The range of alternatives identified were organized into four categories:

- Bicycle Improvements
- Multimodal Improvements
- Transit Options
- Vehicle Options

The specific alternatives considered in each category are discussed in the following sections. The alternatives were screened against the established goals and objectives.

Alternatives Screening

Bicycle Improvements

A series of alternatives were developed to improve bicycle connectivity within the study area. The alternatives either address east-west bicycle mobility east of School Street or cross connectivity to adjacent pathways /facilities. As discussed in Chapter 3, bicycle accommodations west of School Street either already exist, are under construction, or are planned by Watertown. Therefore, the alternatives developed for this study focus on improving bicycle accommodations east of School Street.

Alternative 1 – Bike Lanes East of School Street

Alternative 1 would provide a five-foot bike lane in each direction of Arsenal Street east of School Street. To accomplish this, travel lanes would be narrowed to 11-feet to provide a variable-width (but less than five-foot) bike lane in each direction. The resulting curb-to-curb width would be 54-feet (exclusive of turn lanes).

Alternative 1 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 1 may reduce auto dependency, leading to a potential decrease in traffic congestion.
- **Safety Improvements:** Alternative 1 does not result in a targeted safety improvement but often provide a higher level of comfort for the less experienced biker.
- **Accessibility and Connectivity Benefits:** May reduce auto dependency, improve connectivity, and support active transportation initiatives.
- **Economic Development Impacts:** Smaller impact to private property than other east-west bicycle alternatives considered. The provision of formal bike lanes may encourage patronization of local businesses from adjacent residential neighborhoods.
- **Environmental Impacts:** Alternative 1 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Retain Alternative 1 for further refinement and analysis. Analysis of this alternative will identify property impacts and develop typical cross-sections.

Current roadway changes proposed by athenahealth includes the provision of on-road bicycle lanes from School Street to Arsenal Court. Similar to this alternative, these bike lanes are of varying width, averaging 4.5 feet.

Alternative 2 - Off-road, Parallel Connections to Charles River

Alternative 2 would provide an east-west bicycle connection, north of Arsenal Street between the Watertown Greenway and the facilities along Greenough Boulevard. As shown in Figure 4-1[26], the western segment of the path could travel from the Watertown Greenway through Filippello Playground. The eastern segment of the path would utilize Grove Street and/or an undefined off-road alignment.

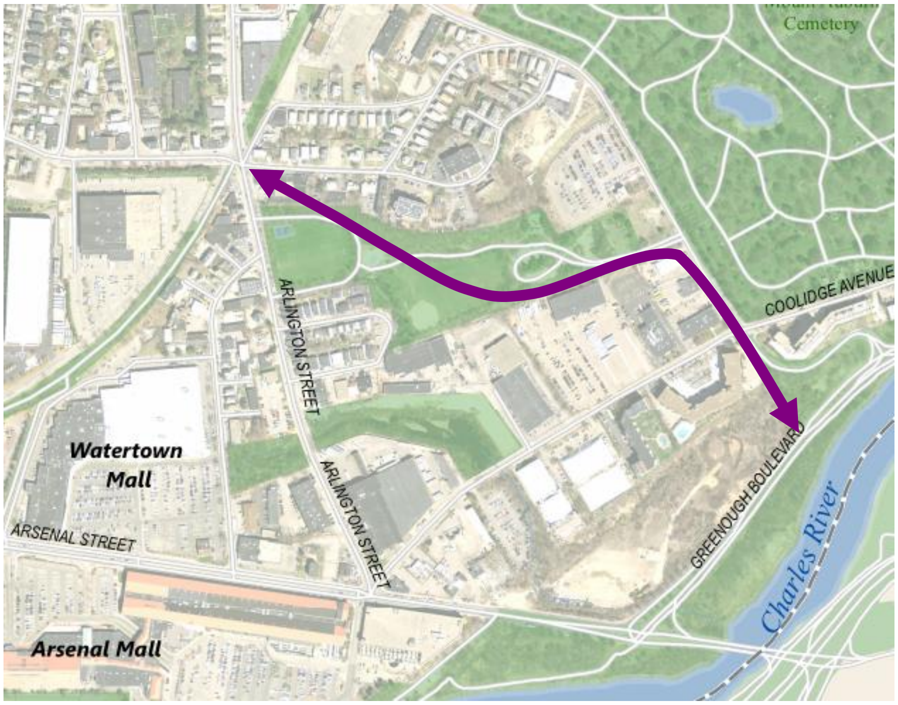

Figure 4-1 Alternative 2 - Off-road, Parallel Connections to Charles River

Alternative 2 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 2 may reduce auto dependency, leading to a potential decrease in traffic congestion.

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[26] Unless noted, aerial map images in Chapters 4 and 5 are sourced from MassGIS.

- **Safety Improvements:** Alternative 2 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** May reduce auto dependency, improve connectivity, and support active transportation initiatives
- **Economic Development Impacts:** Better connection to the regional bicycle network allows for a potential increase in patrons accessing local businesses.
- **Environmental Impacts:** Alternative 2 is not anticipated to have a significant benefit to or impact on the environment.

Two constructability concerns were noted during the screening process. There is a significant grade differential for the segment of Alternative 2 from Coolidge Avenue to Greenough Boulevard. Additionally, the existing curb-to-curb width of Grove Street along this segment would preclude on-road accommodations without roadway widening.

Recommendation: Discard Alternative 2 from consideration due to constructability concerns. Advance an option that provides connections to the Charles River path system the south (Alternative 3). Alternative 2 could be pursued separately by the Town and/or DCR.

Alternative 3 - Cross Connectivity between the Greenway and Charles River

Alternative 3 would provide cross connections between the Watertown Greenway/ Arsenal Street and the Charles River to the south through both public and private property. As shown in Figure 4-2, a variety of connections could be considered, including:

- Irving Street
- Beechwood Avenue
- Wooley Avenue (presently being advanced by athenahealth)
- Talcott Avenue
- Arsenal Court (being advanced by Boylston Properties, anticipated to include shared-use path)
- Arlington Street extension

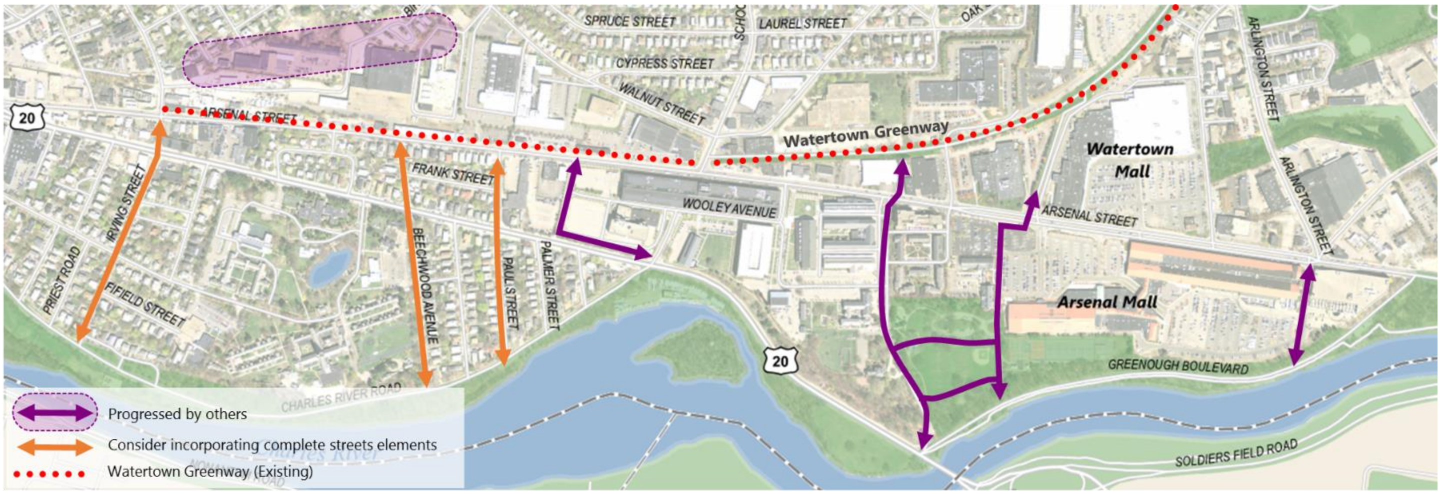

Figure 4-2 Alternative 3 - Cross Connectivity between the Greenway and Charles River

Alternative 3 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 3 may reduce auto dependency, leading to a potential decrease in traffic congestion.
- **Safety Improvements:** Alternative 3 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** May reduce auto dependency, improve connectivity, and support active transportation initiatives
- **Economic Development Impacts:** Better connection to the regional bicycle network allows for a potential increase in patrons accessing local businesses.
- **Environmental Impacts:** Alternative 3 could impact environmental resources at connections to the pathways along Charles River Road/Greenough Boulevard.

Recommendation: Retain Alternative 3 for further refinement and analysis. Analysis of this alternative will identify potential cross-connections and impacted property owners and develop typical cross-sections.

Both athenahealth and Boylston Properties are pursuing cross-connectivity opportunities as part of project development at the Arsenal on the Charles and Arsenal Mall.

Alternative 4 - Separated Bike Lanes East of School Street

Alternative 4 would provide a separated bike lane in each direction of Arsenal Street east of School Street. A separated bike lane is an exclusive space for bicyclists along or within a roadway that is physically separated from motor vehicles and pedestrians by vertical and horizontal elements[27]. For the preliminary screening exercise, three alignments were reviewed for Alternative 4: widening to the north only, widening to the north and south (holding the existing centerline), and widening to the south only. All alignments considered a 69-foot cross-section which included two 11-foot travel lanes, a two-foot buffer, a five-foot bicycle lane, and a 5.5-foot sidewalk in each direction. Where turn lanes are provided, this cross-section would be wider.

Alternative 4 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 4 may reduce auto dependency, leading to a potential decrease in traffic congestion.
- **Safety Improvements:** Alternative 4 could improve safety for bicyclists along roadway segments between intersections, where they are no longer on the roadway. Alternative 4 may create safety concerns at intersections, where right-turning vehicles and bicycle conflicts are high and sight lines are diminished.
- **Accessibility and Connectivity Benefits:** May reduce auto dependency, improve connectivity, and support active transportation initiatives.
- **Economic Development Impacts:** Impacts to adjacent parcel frontage and/or buildings that negatively affect tax base, particularly on the north-side. A sample of the impact analysis (Figure 4-3) identifies impacts to buildings on both sides of Arsenal Street when widening to both the north and the south. The preliminary impact analysis is included in the Appendix for all alignments.
- **Environmental Impacts:** Alternative 4 is not anticipated to have a significant benefit to or impact on the environment.

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[27] MassDOT Separated Bike Lane Planning and Design Guide; MassDOT, 2015.

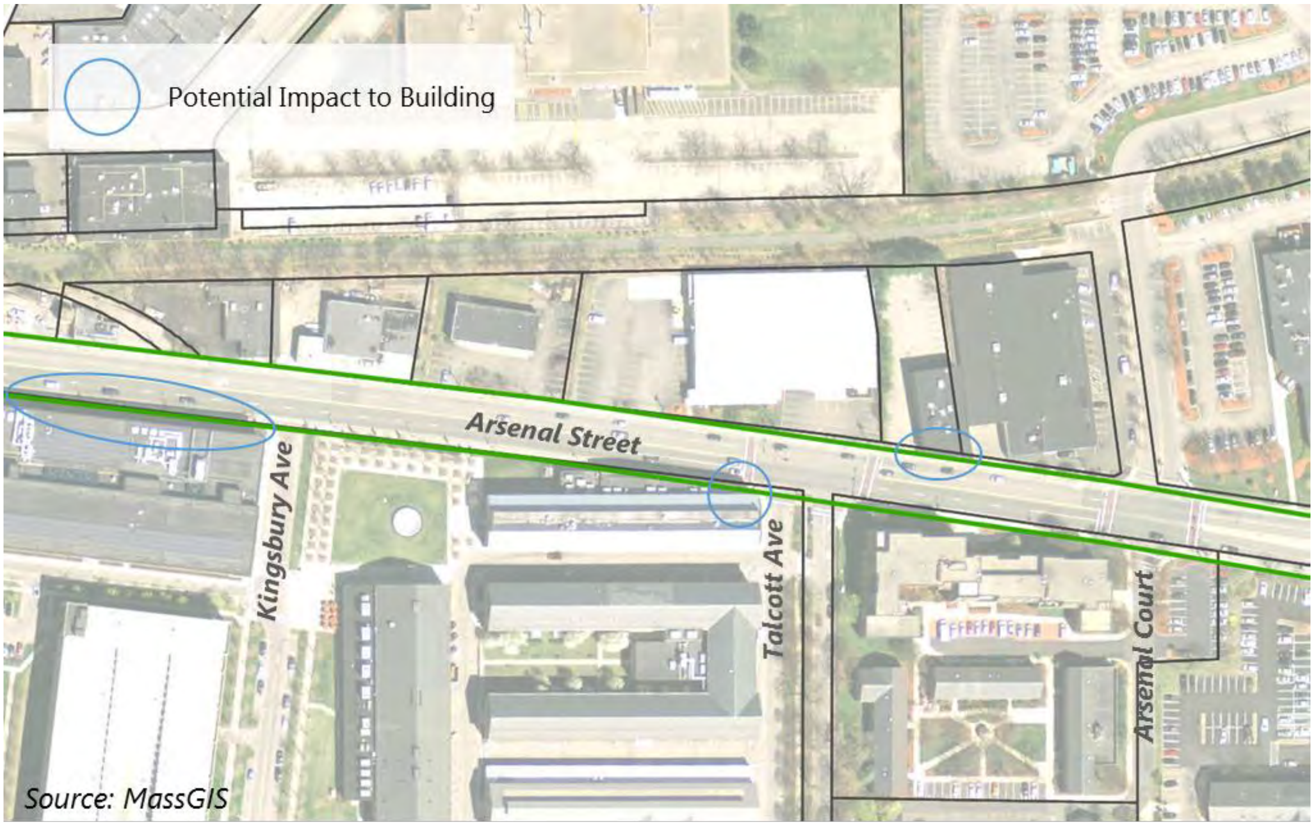

Figure 4-3 Alternative 4: Separated Bike Lanes (Widening to North and South) Preliminary Impact Analysis Example

If the Alternative 4 cross-section were carried to the eastern end of the study area, the bridge over the Charles River and Soldiers Field Road would be impacted for all three alignments considered. The bridge would need to be replaced in order to accommodate 4 vehicular travel lanes, bike lanes, and sidewalks. Reducing the number of vehicle lanes can be considered, but would have significant operational implications.

Recommendation: Discard Alternative 4 from consideration due to impacts to private property. Advance an on-road bicycle accommodation option (Alternative 1). There may be an opportunity to incorporate separated bike lanes along Arsenal Street where right-of-way allows.

Multimodal Improvements

Five multimodal alternatives were developed to take a holistic approach to improving access and mobility for all users within the study area including pedestrians, bicycles, transit riders, and vehicles.

Alternative 5: Road Diet East of School Street

Alternative 5 considers a road diet for the four-lane section, east of School Street. The road diet would reduce the number of general travel lanes to one in each direction and allow for a shared bus-bike lane in each direction on Arsenal Street. The National Association of City Transportation Officials (NACTO) notes that:

The shared bus-bike lane is not a high-comfort bike facility, nor is it appropriate at very high bus volumes… Shared bus-bike lanes can accommodate both modes at low speeds and moderate bus headways, where buses are discouraged from passing, and bicyclists pass buses only at stops.[28]

An example shared bus-bike lane for the Silver Line on Washington Street in Boston's South End is illustrated in Figure 4-4.

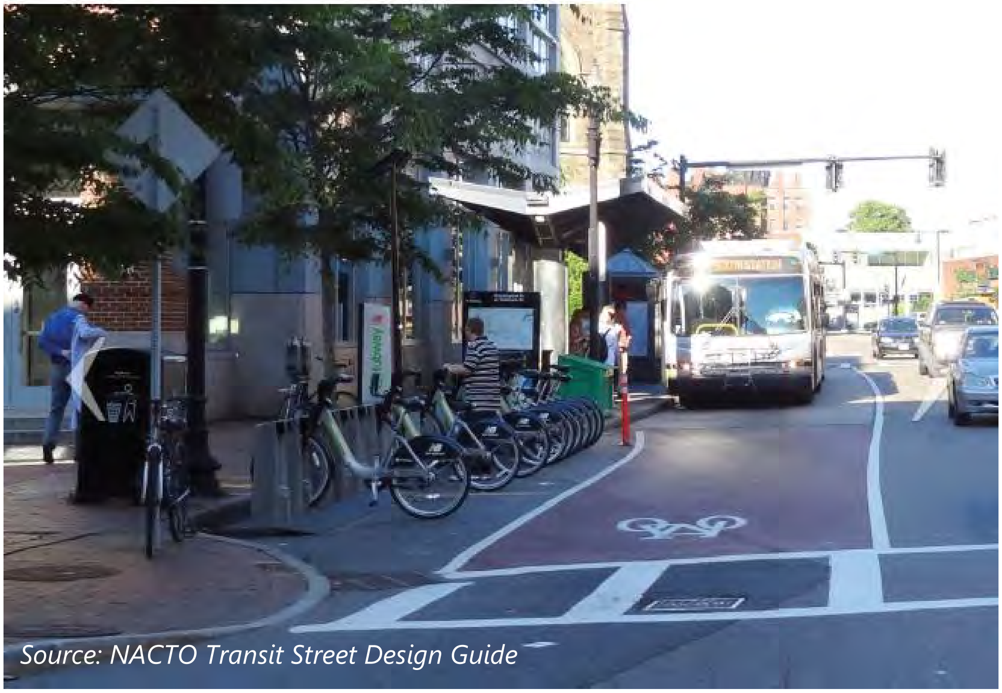
Source: NACTO Transit Street Design Guide

Figure 4-4 Example Shared Bus-Bike Lane, Washington Street, Boston

Alternative 5 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 5 would improve mobility for transit vehicles but would have an operational impact to general traffic and may impact parallel routes by diverting general traffic from Arsenal Street.
- **Safety Improvements:** Alternative 5 does not result in a targeted safety improvement. While there are many examples of successful installation of

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[28] NACTO Transit Street Design Guide; NACTO, April 2016.

bus-bike lanes, care must be taken in designing such a facility to ensure adequate sight lines and the ability for bikes and buses to appropriately share space.

- **Accessibility and Connectivity Benefits:** Generally improves public health and quality of life by prioritizing transit and bicycle mobility.
- **Economic Development Impacts:** A reduction in traffic along the corridor may diminish pass by patronage of local businesses.
- **Environmental Impacts:** Alternative 5 may increase localized greenhouse gas emissions by increasing congestion for general traffic. On a regional scale these impacts would be negligible because there is not expected to be a substantive shift in mode share.

Recommendation: Retain Alternative 5 for further refinement and analysis due potential multimodal benefits. Analysis of this alternative will include a roadway capacity threshold evaluation and identification of potentially impacted parallel routes.

Alternative 6: Soldiers Field Road Gateway Improvement

Alternative 6 considers improvements to the eastern end of the Arsenal Street study area from Birmingham Parkway/Soldiers Field Road to Arlington Street/Coolidge Avenue. Potential improvements include signal timing/phasing modifications, intersection geometry changes, incorporation of pedestrian accommodations, restriping to improve lane alignment between Arlington Street and Greenough Boulevard, and/or the potential to relocate Coolidge Avenue as shown in Figure 4-5.

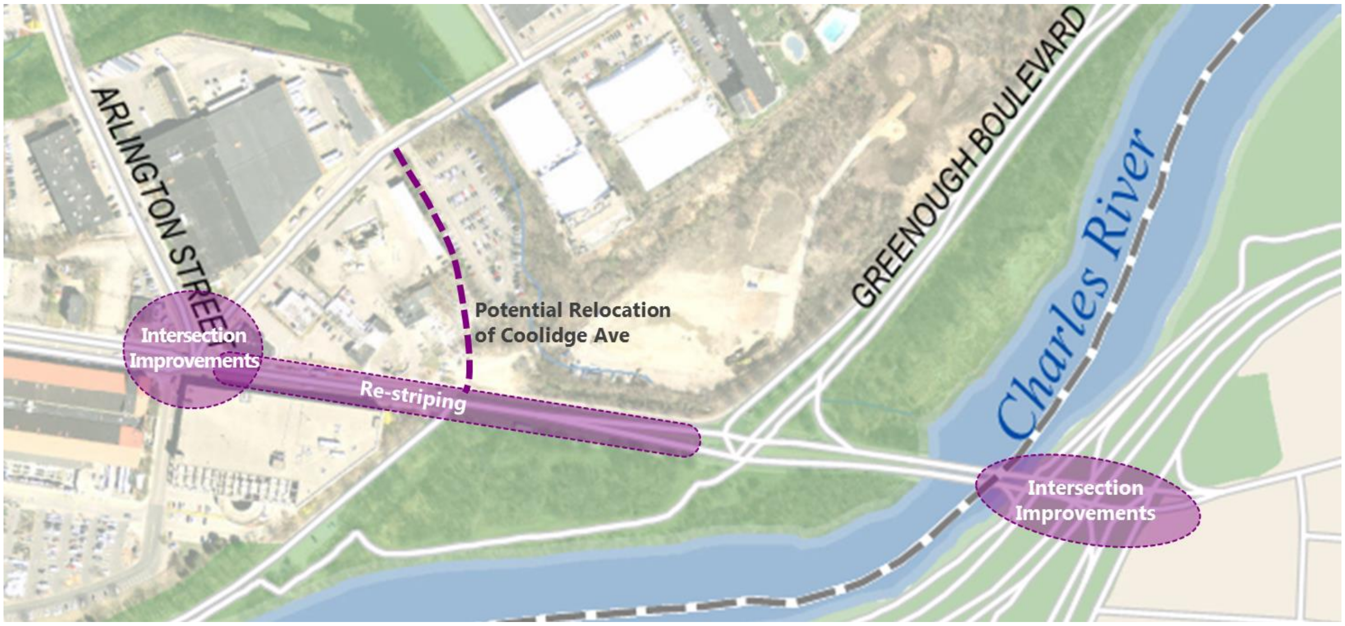
ARLINGTON STREET
GREENOUGH BOULEVARD
Charles River
Potential Relocation of Coolidge Ave
Intersection Improvements
Re-striping
Intersection Improvements

Figure 4-5 Potential Soldiers Field Road Gateway Improvements

Alternative 6 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 6 could improve traffic operations and system reliability by reducing signal delays at critical intersections. Restriping a portion of Arsenal Street could reduce driver confusion and enhance mobility. Relocating Coolidge Avenue opposite Greenough Boulevard (south) may require installation of a traffic signal, potentially increasing delays for the Arsenal Street mainline.
- **Safety Improvements:** Alternative 6 could work to address safety deficiencies at Greenough Boulevard (south) and Birmingham Parkway/Soldiers Field Road.
- **Accessibility and Connectivity Benefits:** Alternative 6 could improve multimodal access and connectivity and generally supports active transportation initiatives.
- **Economic Development Impacts:** Improving traffic flow at the corridor gateways can stimulate economic development. However, the relocation of Coolidge Avenue could have potential impacts to the Mount Auburn Health Club parking lot and/or Aggregate Industries operations.
- **Environmental Impacts:** Alternative 6 could impact environmental resources and require coordination with MassDEP, particularly if relocation of Coolidge Avenue is considered.

Recommendation: Retain Alternative 6 for further refinement and analysis. Analysis of this alternative will evaluate signal timing/phasing modifications, intersection geometry changes, incorporation of pedestrian accommodations, restriping to improve lane alignment between Arlington Street and Greenough Boulevard, and/or the potential to relocate Coolidge Avenue.

Alternative 7: Watertown Square Gateway Improvement

Alternative 7 considers improvements to the western end of the Arsenal Street study area at the intersections of Mount Auburn Street at Main Street/Arsenal Street/Charles River Road (Watertown Square); and Watertown Street/Nonantum Road at Galen Street. Potential improvements include signal timing/phasing modifications, improved coordination between the two intersections, lane use changes, pedestrian accommodation enhancements, and/or the potential to relocate Charles River Road as shown in Figure 4-6.

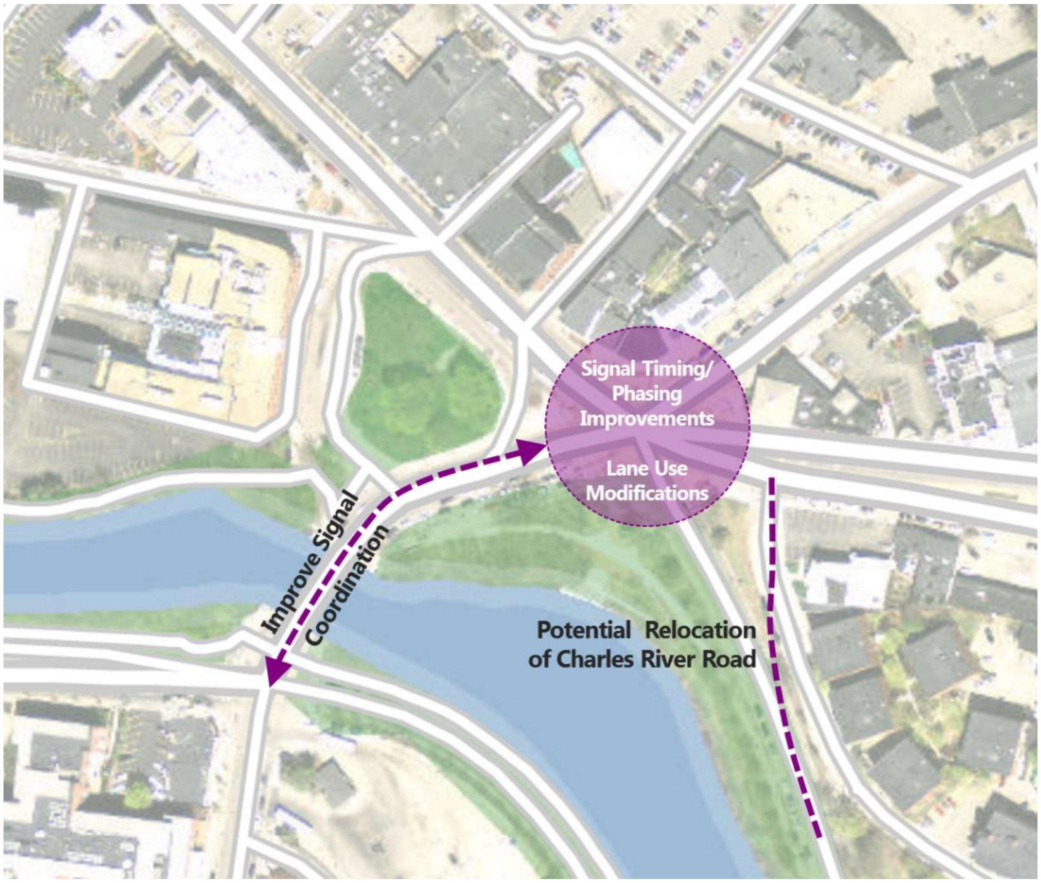
Signal Timing/ Phasing Improvements
Lane Use Modifications
Improve Signal Coordination
Potential Relocation of Charles River Road

Figure 4-6 Potential Watertown Square Gateway Improvements

Alternative 7 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 7 could improve traffic operations and system reliability by reducing signal delays. Lane use modifications and signal phasing adjustments could reduce driver confusion and enhance mobility through Watertown Square.
- **Safety Improvements:** Alternative 7 could work to address safety deficiencies at both intersections.
- **Accessibility and Connectivity Benefits:** Alternative 7 could improve multimodal access and connectivity and generally supports active transportation initiatives.
- **Economic Development Impacts:** Similar to Alternative 6, improvements to traffic flow at the corridor gateways can stimulate economic development.
- **Environmental Impacts:** Alternative 7 would require coordination with DCR and the Office of Energy and Environmental Affairs (EEA) through the Article 97 process. Alternative 7 may also require coordination with MassDEP for impacts to environmental resources.

Recommendation: Retain Alternative 7 for further refinement and analysis. Analysis of this alternative will evaluate signal timing/phasing modifications, improved coordination between the two intersections, lane use changes, pedestrian accommodation enhancements, and/or the potential to relocate Charles River Road.

Alternative 8: Traffic Signal Optimization

Alternative 8 involves optimizing the timings at existing signals within the study area. Signal optimization is a cost-effective measure that can reduce congestion and improve traffic flow. Retiming can also allow for improved pedestrian crossings at locations with pedestrian signal accommodations.

It should be noted that signal timing optimization is being progressed independently as part of on-going development projects within the study area. These projects, as discussed previously in Chapter 3, include a hotel (which has since been opened), and redevelopment of several properties in the center of the corridor from industrial to mixed use.

Alternative 8 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 8 could improve traffic operations and system reliability by reducing signal delays at critical intersections.
- **Safety Improvements:** Alternative 8 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** Improvements may enhance pedestrian crossing times at isolated locations. Overall Alternative 8 does not address corridor access/connectivity or public health goals.
- **Economic Development Impacts:** Alternative 8 would not affect economic development along the corridor.
- **Environmental Impacts:** Alternative 8 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Discard Alternative 8 from consideration as retiming is being progressed as part of on-going development projects within the study area. Advance corridor-wide signal coordination option, which may include adaptive signal control (Alternative 17).

Alternative 9: Wayfinding

Alternative 9 considers pedestrian and bicycle-scale wayfinding signage along the Arsenal Street corridor to guide non-motorized users to key destinations and connecting pathways.

Alternative 9 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 9 would not result in mobility benefits.
- **Safety Improvements:** Alternative 9 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** Installation of wayfinding signage could enhance pedestrian and bicycle awareness of available facilities, particularly off-road accommodations. As a stand along improvement, Alternative 9 does not address corridor access/connectivity or public health goals.
- **Economic Development Impacts:** Alternative 9 would not affect economic development along the corridor.
- **Environmental Impacts:** Alternative 9 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Discard Alternative 9 from consideration as a stand-alone improvement. Consider incorporating wayfinding signage into preferred bicycle alternative and/or gateway alternatives (Alternatives 6 and 7).

Transit Options

A primary focus of the study is to improve bus service along Arsenal Street and locations where the bus service ties into other crossing bus routes. Seven transit alternatives were developed to consider improvements to transit operations, amenities, and/or connectivity.

Alternative 10: Express Bus Service along North Beacon Street

Alternative 10 considers supplementing the existing MBTA Route 70/70A service with bus service along North Beacon Street. Multiple routes were considered during the alternative development phase including Watertown Square to MBTA Commuter Rail (Boston Landing), Green Line, and/or Red Line services.

This alternative originally considered bus rapid transit (BRT) service. While BRT-style elements could be incorporated, a dedicated right-of-way would not be feasible for the entire length of the route. As an alternate, express bus service with limited stops was considered.

Alternative 10 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 10 may reduce auto dependency, leading to a potential decrease in traffic congestion.
- **Safety Improvements:** Alternative 10 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** Alternative 10 could improve connections to existing regional transit services and generally supports active transportation initiatives.
- **Economic Development Impacts:** If this alternative were to draw pedestrian traffic away from the Arsenal Street corridor, it could affect local businesses.
- **Environmental Impacts:** The ability to shift from auto to transit mode share may benefit the environment.

Recommendation: Retain Alternative 10 for further refinement and analysis. Analysis of this alternative will evaluate whether the service could draw sufficient ridership to warrant full study.

Alternative 11: Transit Signal Priority (TSP)

Alternative 11 considers implementation of Transit Signal Priority (TSP) along Arsenal Street. TSP is a strategy that facilitates the movement of buses through signalized intersections. For example, TSP could detect a bus approaching a signal and either extend the green time or shorten the red time to allow the bus to process through the intersection. Implementation of TSP can improve transit quality of service by enhancing schedule adherence and reducing transit travel times. Impacts to non-transit traffic operations are generally minimal.

Alternative 11 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 11 may reduce auto dependency, leading to a potential decrease in traffic congestion. Implementation of TSP may result in a minor increase to cross street traffic delay.
- **Safety Improvements:** Alternative 11 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** Alternative 11 could improve the quality of existing bus services by enhancing schedule adherence and reducing transit travel times.

- **Economic Development Impacts:** Alternative 11 would not affect economic development along the corridor. Benefits could be gained by improving transit along the corridor, thereby encouraging use.
- **Environmental Impacts:** Alternative 11 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Retain Alternative 11 for further refinement and analysis. Analysis of this alternative will include queue bypass lanes, traffic signal timing/phasing options, and the need to relocate or consolidate bus stops.

Alternative 12: Watertown Square Bus Alternative

The inbound Route 70/70A currently stops on Main Street at Cross Street. Passengers transferring to Route 59 or Route 71 are required to walk approximately 450 feet to the Watertown Square Delta. In 2008, Traffic Solutions, LLC was retained by the Town to evaluate options to relocate the Route 70/70A stop closer to the Watertown Square Delta[29]. The study recommended relocating the stop to within the Watertown Square Delta, requiring the Route 70/70A to travel through the Watertown Square signal twice. Alternative 12 considers the alternatives and recommendation of the previous study and other potential opportunities to improve transit quality of service within Watertown Square.

Alternative 12 was screened against the study goals and objectives:

- **Mobility Benefits:** If combined with other measures, Alternative 12 may reduce auto dependency, leading to a potential decrease in traffic congestion.
- **Safety Improvements:** Alternative 12 allows bus transfers to occur within better proximity of the two bus routes and improves sight lines between bus drivers. This may indirectly improve pedestrian safety because it is likely to reduce the number of pedestrian running to meet a connecting bus.
- **Accessibility and Connectivity Benefits:** Alternative 12 could improve the quality of existing bus services by reducing passenger transfer time.
- **Economic Development Impacts:** Alternative 12 would not affect economic development along the corridor.
- **Environmental Impacts:** Alternative 12 is not anticipated to have a significant benefit to or impact on the environment.

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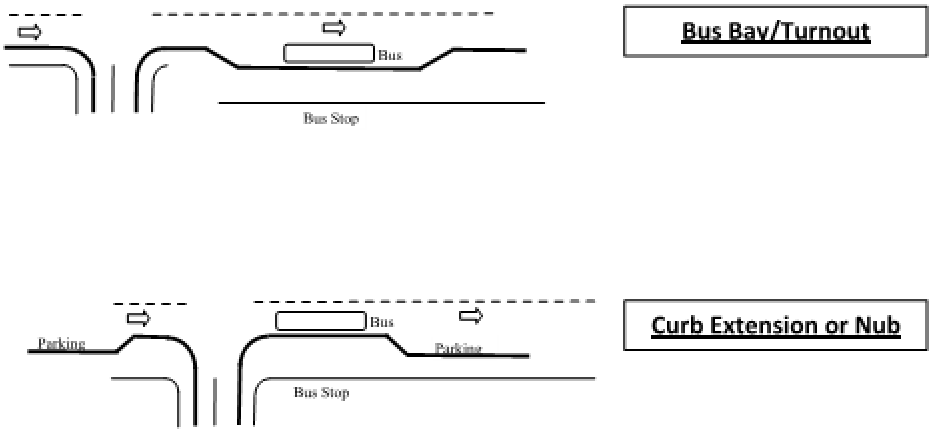
[29] Watertown – MBTA Bus Study memorandum; Traffic Solutions, LLC. July 30, 2008.

Recommendation: Discard Alternative 12 from consideration as a stand-alone improvement. Incorporate bus operations improvements into the Watertown Square gateway alternative (Alternative 7).

Alternative 13: Transit Stop Turnouts/Curb Extensions

Alternative 13 considers improving the existing transit stops along Arsenal Street by incorporating bus bays/turnouts or curb extensions. Bus bays create a space for the bus to exit the travel lanes completely for passenger boarding and alighting. These types of stops minimize impacts to through traffic, but require buses to merge back into the travel lanes. Curb extensions to create an in-lane stop, reducing lost time for buses merging in and out of traffic. These types of stops may block the travel lane, impacting general traffic. Figure 4-7 illustrates an example of bus stop turnouts and curb extensions.



Source: Draft MBTA Bus Stop Planning and Design Guideline, Oct 2013

Figure 4-7 Bus Stop Turnouts and Curb Extensions

Alternative 13 was screened against the study goals and objectives:

- **Mobility Benefits:** If combined with other measures, Alternative 13 may reduce auto dependency, leading to a potential decrease in traffic congestion.
- **Safety Improvements:** Alternative 13 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** Alternative 13 could improve the quality of existing bus services by providing transit passenger amenities.
- **Economic Development Impacts:** Alternative 13 would not adversely affect economic development along the corridor.

- **Environmental Impacts:** Alternative 13 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Retain Alternative 13 for further refinement and analysis. Analysis of this alterative will consider spatial constraints with respect to ADA guidelines and qualitatively assess the benefits with respect to on-time performance and travel time improvements for bus bays versus curb extensions.

Alternative 14: Transit Shelters

Alternative 14 considers installation of shelters at existing bus stops to increase passenger comfort and facilitate improved bus stop identification. The MBTA provides guidance for the placement of bus shelters, primarily based on passenger utilization (i.e. boardings) but also considering other factors[30]. According to MBTA policies, a site must receive a total of 70 points to be considered eligible for a shelter. Existing bus stops along Arsenal Street were screened according to the MBTA criteria and based on the evaluation eight stops along Arsenal Street are eligible for shelters:

- Stop 1435: at Louise St
- Stop 1436: Arsenal opposite School St
- Stop 1437: at Arsenal Court
- Stop 1438: 500 Arsenal Watertown + Arsenal Mall
- Stop 1441: opposite Elm St
- Stop 1442: opposite Arlington St
- Stop 1445: Watertown + Arsenal Mall
- Stop 1447: opposite Arsenal Court Drive

The results of this evaluation are presented in the Appendix.

The eight bus stops which meet MBTA criteria for a shelter were screened against the study goals and objectives:

- **Mobility Benefits:** If combined with other measures, Alternative 14 may reduce auto dependency, leading to a potential decrease in traffic congestion.
- **Safety Improvements:** Alternative 14 does not result in a targeted safety improvement.

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[30] Bus Stop Planning & Design Guidelines Draft v.3; MBTA, October 2013.

- **Accessibility and Connectivity Benefits:** Alternative 14 could improve the quality of existing bus services by providing transit passenger amenities. This alternative generally supports active transportation initiatives.
- **Economic Development Impacts:** Alternative 14 would not affect economic development along the corridor. Benefits could be gained by improving transit along the corridor, thereby encouraging use.
- **Environmental Impacts:** Alternative 14 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Retain Alternative 14 for further refinement and analysis. Analysis of this alterative will consider spatial requirements for installation of a shelter and identify existing constraints to the extent feasible.

Alternative 15: Existing Transit Service Improvements

Alternative 15 incorporates several independent alternatives that consider operational improvements to the MBTA's existing Route 70 and 70A services including:

- Terminal adjustments for some or all trips (to Watertown Square)
- Terminal adjustments for some or all trips (to Waltham Center)
- Splitting the Route 70/70A into three distinct and shorter routes
- Adding express service
- Combining segments of the Route 70A with other existing MBTA bus routes
- Service frequency adjustments
- Trip schedule adjustments

Alternative 15 was screened against the study goals and objectives:

- **Mobility Benefits:** By improving the capacity and reliability of transit service on the corridor, Alternative 15 is anticipated to encourage mode shifts to transit and reduce auto dependence, which could lead to a decrease in traffic congestion. Adding express bus service to the corridor would reduce travel times between express stop locations, resulting in improvements to transit mobility.
- **Safety Improvements:** Alternative 15 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** Alternative 15 could improve transit service reliability and generally supports active transportation initiatives.

Alternative 15 has the potential to increase transit accessibility to key attractions (such as employment, education, and shopping centers) by providing increased transit capacity and reduced trip times for passengers.

- **Economic Development Impacts:** Alternative 15 may modestly improve economic development opportunities by providing a more reliable service and potentially drawing patrons from a larger capture area.
- **Environmental Impacts:** Alternative 15 is not anticipated to have a significant negative impact on the environment and may result in environmental benefits. Alternative 15 would support smart growth initiatives by providing increased transit capacity and improved reliability to the corridor. The Alternative 15 service improvements also have the potential to reduce regional greenhouse gas emissions through mode shifts from auto to transit, which would be encouraged by improved transit reliability, travel times, capacity and comfort.

Recommendation: Retain Alternative 15 for further refinement and analysis. Analysis of this alternative will consider impacts to on-time performance, passenger crowding, and travel times for each of the potential operational improvements outlined above.

Alternative 16: Consolidated Shuttle Services

Alternative 16 considers combined shuttle service to collectively serve developments along Arsenal Street. At this time, athenahealth runs private shuttle service and several other developers along the corridor are planning or have committed to providing service to regional transportation nodes such as Harvard Square and/or off-site employee parking.

Alternative 16 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 16 may reduce auto dependency, leading to a potential decrease in traffic congestion.
- **Safety Improvements:** Alternative 16 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** Alternative 16 could improve transportation options and generally supports active transportation initiatives.
- **Economic Development Impacts:** Alternative 16 would not affect economic development along the corridor.
- **Environmental Impacts:** Alternative 16 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Discard Alternative 16 from consideration due to limited operational services at this time. This alternative could be pursued by others such as the planned Watertown Transportation Management Association (TMA) at a later date when there are services from multiple employers operational and when robust ridership data is available to support the consolidation decision making process.

Vehicle Options

Two alternatives were developed to specifically address vehicular operations and mobility.

Alternative 17: Adaptive Signal Control

Alternative 17 considers implementing adaptive signal control (ASC) along the Arsenal Street corridor. ASC technologies are able to capture and respond to real-time traffic demands to optimize traffic flow and progression in a coordinated signal system by adjusting cycle length, phase splits, and offsets. ASC can result in reduced travel times, intersection delay, and vehicle emissions – making more efficient use of the roadway network.

Alternative 17 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 17 may decrease congestion and reduce delays and improve system reliability.
- **Safety Improvements:** Alternative 17 does not result in a targeted safety improvement.
- **Accessibility and Connectivity Benefits:** By decreasing congestion, Alternative 17 could improve transit service run-time and reliability. Overall Alternative 17 does not address multimodal corridor access/connectivity or public health goals.
- **Economic Development Impacts:** Alternative 17 would not affect economic development along the corridor but may make the movement of goods easier outside of peak hours.
- **Environmental Impacts:** Alternative 17 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Retain Alternative 17 for further refinement and analysis. Analysis of this alterative will consider various ASC technologies and evaluate their appropriateness for the Arsenal Street corridor.

Alternative 18: Overhead Lane Indication Signage

During the existing conditions analysis and public outreach process, driver confusion regarding proper lane usage was noted particularly in Watertown Square. Alternative 18 would provide supplemental directional signage in Watertown Square.

Alternative 18 was screened against the study goals and objectives:

- **Mobility Benefits:** Alternative 18 does not result in notable mobility benefits.
- **Safety Improvements:** Alternative 18 does not result in a targeted safety improvement, although it may reduce driver confusion.
- **Accessibility and Connectivity Benefits:** Alternative 18 does not address multimodal corridor access/connectivity or public health goals.
- **Economic Development Impacts:** Alternative 18 would not affect economic development along the corridor.
- **Environmental Impacts:** Alternative 18 is not anticipated to have a significant benefit to or impact on the environment.

Recommendation: Discard Alternative 18 from consideration as a stand-alone improvement. Incorporate potential supplemental lane indication signage into the Watertown Square gateway alternative (Alternative 7).

Summary

This chapter presented the range of alternatives that were identified and screened against the study goals and objectives. The results of the alternatives screening process are presented in Table 4-1.

The alternatives that were recommended for further consideration will be reevaluated and further refined in Chapter 5, Alternatives Analysis. Chapter 6 will identify potential packaging of the alternatives into short, mid, and long-term recommendations.

Table 4-1 Alternatives Screening Summary

Retained for Further Evaluation	Discarded from Consideration	Comments
Alternative 1: Bike Lanes East of School Street		Analysis will identify property impacts and develop typical cross-sections and consider planned athenahealth improvements.
	Alternative 2: Off-Road, Parallel Connections to Charles River	Discarded due to constructability concerns and in favor of Alternative 3. Alternative 2 could be pursued separately by the Town and/or DCR.
Alternative 3: Cross Connectivity between the Greenway and Charles River		Analysis will identify potential cross-connections and impacted property owners and develop typical cross-sections.
	Alternative 4: Separated Bike Lane East of School Street	Discarded due to impacts to private property. There may be an opportunity to incorporate separated bike lanes along Arsenal Street where right-of-way allows into Alternative 1.
Alternative 5: Road Diet East of School Street		Analysis will include a roadway capacity threshold evaluation and identification of potentially impacted parallel routes.
Alternative 6: Soldiers Field Road Gateway Improvement		Analysis will evaluate signal timing/phasing modifications, intersection geometry changes, incorporation of pedestrian accommodations, restriping, and/or Coolidge Avenue relocation.
Alternative 7: Watertown Square Gateway Improvement		Analysis will evaluate signal timing/phasing modifications, improved coordination, lane use changes, pedestrian accommodation enhancements, and/or Charles River Road relocation.
	Alternative 8: Traffic Signal Optimization	Discard as retiming is being progressed as part of on-going development projects within the study area.
	Alternative 9: Wayfinding	Discarded as a stand-alone improvement. Consider incorporating into preferred bicycle alternative and/or Alternatives 6 and 7.
Alternative 10: Express Bus along North Beacon Street		Analysis will evaluate whether the service could draw sufficient ridership to warrant full study.
Alternative 11: Transit Signal Priority (TSP)		Analysis will include queue bypass lanes, traffic signal timing/phasing options, and bus stop relocation/consolidation.
	Alternative 12: Watertown Square Bus Alternative	Discarded as a stand-alone improvement. Consider incorporating into Alternative 7.
Alternative 13: Transit Stop Turnouts/Curb Extensions		Analysis will consider spatial constraints (ADA guidelines) and qualitatively assess benefits to on-time performance and travel time improvements for bus bays versus curb extensions.
Alternative 14: Transit Shelters		Analysis will consider spatial requirements for installation of a shelter and identify existing constraints to the extent feasible.
Alternative 15: Existing Transit Service Improvements		Analysis will consider impacts on on-time performance, passenger crowding, and travel times of each sub-alternative.
	Alternative 16: Consolidated Shuttle Service	Discarded due to limited operational services at this time. Could be pursued by others when there are services from multiple employers operational.
Alternative 17: Adaptive Signal Control (ACS)		Analysis of this alterative will consider various ACS technologies and evaluate their appropriateness for the Arsenal Street corridor.
	Alternative 18: Overhead Lane Indication Signage	Discarded as a stand-alone improvement. Consider incorporating into Alternative 7.

Immediate (0 to 1 year) Recommendations

In addition to the alternatives screened above, a series of improvements were identified for immediate implementation by the Town. Immediate-term actions address existing safety and operational deficiencies or advance some aspects of longer-term improvement projects. For the most part, the improvements can be completed within one year and include low-cost options that do not require environmental permitting, prolonged design or approvals, or extensive community vetting.

Immediate-term recommendations fall into three categories discussed below: road safety audits (RSAs), traffic signal deficiencies/compliance, and curb ramp improvements.

Road Safety Audits (RSAs)

An RSA is a formal safety examination of a roadway or intersection conducted by an independent, experienced multidisciplinary RSA team. MassDOT requires an RSA for all HSIP-eligible locations that fall within a project area prior to submittal of 25-percent design plans. Additionally, the RSA program has recently been expanded to focus on pedestrian and bicycle hot spots.

There are five HSIP-eligible crash clusters within the Arsenal Street study area:

- Arsenal Mall (unsignalized) at Arsenal Street
- Greenough Boulevard (south) at Arsenal Street
- Mount Auburn Street/ Main Street/ Arsenal Street/ Charles River Road (bicycle)
- Arsenal Street at Soldiers Field Road and Western Ave at Birmingham Parkway (bicycle)
- Galen Street/ Nonantum/Watertown Street and Mount Auburn Street/ Main Street/ Arsenal Street/ Charles River Road (pedestrian)

Additionally, the intersection of Galen Street at Nonantum Road/ Watertown Street is ranked 178 in the 2011-2013 Statewide Top 200 Intersection Crash List. An RSA was conducted at this location in Fall 2016. The detailed RSA results are provided in the Appendix. The primary recommendations supported by the findings of this study include:

- Changes to the traffic signal phasing and the incorporation of a yellow flashing arrow (note these changes may necessitate replacement of the traffic signal controller)
- Changes to pedestrian phasing and increased clearance intervals
- Geometric changes to the Watertown Yard Driveway

For the remaining locations, it is recommended that the Town continue work with MassDOT to conduct RSA’s as appropriate.

Traffic Signal Deficiency/Compliance

The traffic signal and controller equipment at the 14 signalized intersections within the study area were reviewed. A table summary with locations reviewed and recommended actions can be found in the Appendix. While issues relating to MUTCD compliance, ADA compliance, and operations/maintenance were noted at all locations, three locations had noted safety deficiencies that should be addressed as soon as possible:

- Watertown Street/Nonantum Road at Galen Street: Pedestrian phase issue
- North Beacon Street/Arsenal Street/Taylor Street at Alfred Street: Multiple pedestrian phase issues
- Arsenal Street at Soldiers Field Road/ Birmingham Parkway: Permissive left-turn against vertical green arrow

Curb Ramp Improvements

VHB inventoried 91 curb ramps within the study area in November 2015. Of the non-compliant ramps, 37 locations require only a tactile warning strip, with the other features meeting current regulations. Addition of a tactile warning strip at these locations would make the ramp fully compliant. A table summarizing all curb-ramps reviewed and the recommended actions can be found in the Appendix.

5

Alternatives Analysis

Chapter 4 presented a preliminary screening of alternatives that were identified as having the potential to address the corridor's transportation system issues and deficiencies and to meet the goals and objectives of the study. This chapter presents more detailed evaluations of the alternatives progressed.

Alternatives Analysis

This section expands on the previous discussion for each alternative progressed for further study. The details of each analysis vary for each alternative, based on the specific evaluation criteria relevant to the alternative.

Alternative 1: Bike Lanes East of School Street

Alternative 1 would provide a five-foot bike lane in each direction of Arsenal Street east of School Street to the Charles River. As noted in Chapter 4, narrowing the travel lanes to 11-feet would not be sufficient to create enough space for the provision of five-foot bike lanes within the existing right-of-way. Therefore, this analysis considered two options:

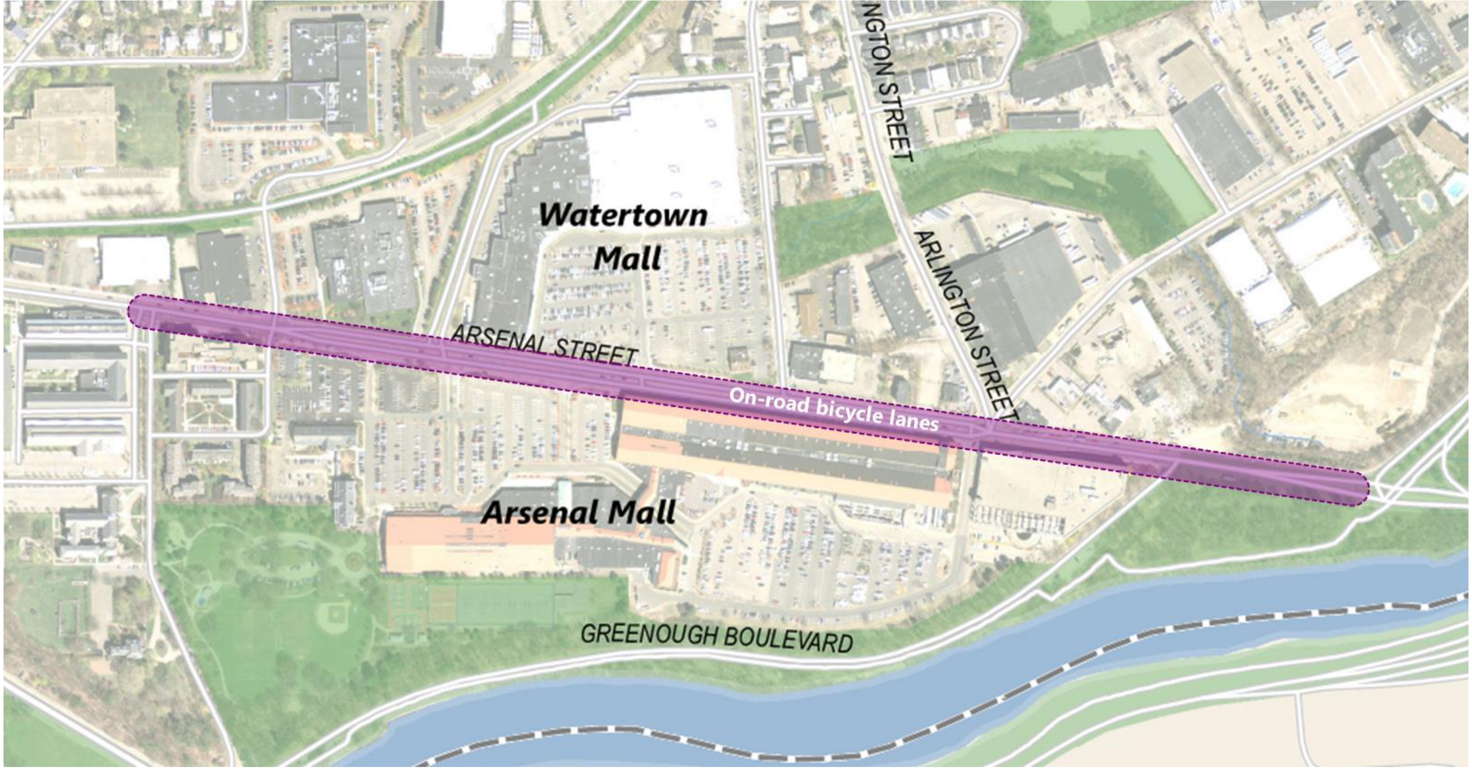
- Maintaining consistent five-foot bike lanes while further narrowing the outside travel lanes where necessary. The outside travel lane along the corridor would vary from 10.3 feet to 10.9 feet.
- Maintaining 11 foot outside travel lanes and providing a variable width bike lane from 4.2 feet 4.9 feet.

Once east of Arlington Street, 11-foot travel lanes and five-foot bike lanes could be accommodated approaching Greenough Boulevard. West of School Street, the bike lanes would connect with the existing two-way bike path (north side) to form a continuous bike route along Arsenal Street from Irving Street to the river (with planned connections further west in the future). The improved biking connectivity along the corridor is likely to encourage biking as an alternative means of traveling and therefore reduce auto dependency. From a public health perspective, it could have a positive impact by reducing vehicle miles traveled and automobile congestion on Arsenal Street and results in reduced greenhouse gas emissions and transportation-related noise. It also encourages Complete Streets as a component of healthy community design. Alternative 1 has limited or neutral impacts on safety, public transit service, and the natural environments along the corridor.

While MassDOT's minimum width for bicycle lanes is five feet, federal guidance allows some flexibility for areas with constrained right-of-way. Based on that guidance, either option could be appropriate for the corridor. Also, athenahealth has recently proposed installing bicycle lanes along Arsenal Street in front of their property, from Wooley Avenue to Talcott Avenue, that are slightly less than five feet wide. Their proposed changes require restriping the roadway within the existing curb to curb width, with no alterations to sidewalk or private property. As shown in Figure 5-1, the project limits of Alternative 1 would ultimately meet the athenahealth project, providing a more uniform cross-section if the bike lanes are of roughly the same width. Varying the width of the bike lane, as opposed to the outside travel lane was also preferred by the town, which has established a 11-foot minimum width for vehicular travel lanes.

A review of available 1997 ground survey data along Arsenal Street allowed for the development of a conceptual plan to determine right-of-way constraints along the corridor and the expected varying width of the bike lanes. This full plan is provided in the Appendix. The conceptual plan holds 11-foot travel lanes, 10-foot turn lanes, and existing median widths along Arsenal Street. In general, once past the Arsenal Mall driveway, the right-of-way widens to provide 4.9-foot bike lanes on the south side of the roadway and 4.5-foot bike lanes on the north side of the roadway. The corridor generally widens to the east and the most constrained (or narrow) area is between Talcott Avenue and the main Arsenal Mall driveway.

Figure 5-1 Alternative 1 On-road Bicycle Lanes



Note: The western boundary at Talcott Avenue has been identified by the town as the limits of the athenahealth project.

Figure 5-2 illustrates a possible cross-section within the constrained area, which would provide 11-foot travel lanes and 4.3-foot bicycle lanes or shoulders. As the town develops this alternative further, consideration should be given wherever possible to modification of medians and the potential to shift the roadway center line to maximize the space available for bicyclists.

Figure 5-2 Alternative 1 Cross-Section Example in Areas with Constrained Rights Of Way

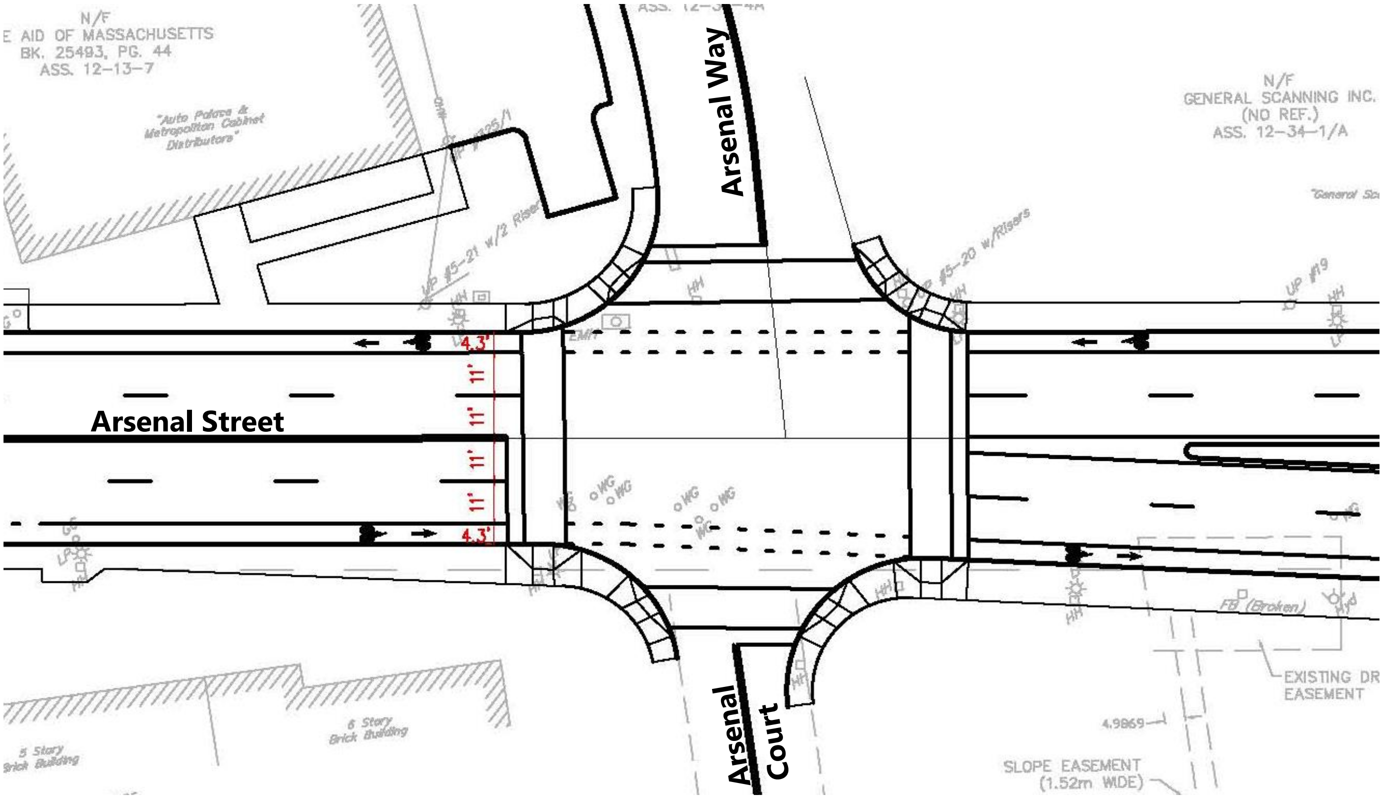


Table 5-1 considers the results of the analysis discussed above, summarizes the complete evaluation of Alternative 1 against the study goals and objectives, and provides a preliminary order-of-magnitude construction cost estimate. The cost for this alternative would be based on the construction methods preferred by the town. For example, the town may choose to remove the existing striping and restripe with new paint or remove a thin layer of asphalt and repave the road. A range of costs are provided to account for this. The inclusion of dedicated bike lanes along the corridor is a short-term recommendation.

Table 5-1 Alternative 1 Evaluation and Recommendation

✓	Positive Impact
●	Neutral Impact
✗	Negative Impact
PHO	Public Health Objective

Goals	Objectives	Impact	Comments
Mobility Benefits	Decrease congestion and reduce delays (PHO)	●[1]	1. This alternative focuses on encouraging means of non-motorized transportation, with the overall ambition of improving mobility over the longer-term.
	Improve system reliability	●[1]	
	Minimize local street impacts	●[1]	
	Maintain emergency vehicle and first responder mobility	●[1]	
Safety Improvements	Identify, eliminate, or mitigate locations and situations that pose hazards (PHO)	●	
	Address current design standard deficiencies (PHO)	●	
Accessibility and Connectivity Benefits	Reduce auto dependency (PHO)	✓	2. Completes a more direct connection between Watertown Square and the Paul Dudley White path system through dedicated accommodations.
	Improve existing public transportation services (PHO)	●	
	Coordinate existing transit services	●	
	Improve bike and pedestrian connections (PHO)	✓[2]	
	Promote active transportation (PHO)	✓	
Economic Development Impacts	Support existing and projected economic development	●	3. Improves connectivity for those that may not have access to automobile or transit options.
	Minimize negative economic effects to tax bases; enhance local and regional economic activity	●	
	Improve non-motorized access and connectivity between business centers and employment centers (PHO)	✓	
	Improve access to the regional highway system	●	
	Avoid/minimize/mitigate social equity impacts	✓[3]	
	Incorporate healthy community design features (PHO)	✓	
Environmental Impacts	Support smart growth, anti-sprawl initiatives (PHO)	●	
	Avoid/minimize/mitigate impacts to the natural environment	●	
	Minimize greenhouse gas emissions (PHO)	✓	
	Reduce CO and particulate matter impacts (PHO)	✓	
	Minimize transportation-related noise impacts along the corridor (PHO)	✓	
Lasting Benefits	Develop a range of multimodal recommendations that support ongoing changes and have lasting benefits	✓[4]	4. Bike lanes can encourage use of non-motorized transportation.
Public Support	Encourage consensus through an open and inclusive process	Yes	
Cost	Preliminary Order-of-Magnitude Construction Cost Estimate	$75,000-$2.1M	Range reflects ability to modify striping only or repave the roadway
Recommendation	***On-road bike lanes are recommended. Where practical, the town should strive to achieve a five-foot width.***		

Alternative 3: Cross Connectivity between the Greenway and Charles River

Alternative 3 would improve access to the Charles River for pedestrians and bicyclists by providing cross connections south from the Watertown Greenway/ Arsenal Street to the river to the south. Several connections, through both public and private property, are being advanced by the Town of Watertown and private developers. These connections are shown in Figure 5-3 and include:

- **athenahealth:** The campus development includes plans to establish a pedestrian/bicycle corridor to the west of a proposed parking garage along Wooley Avenue. The path would be integrated into the proposed traffic signal at the intersection of Arsenal Street and Wooley Avenue, providing a controlled crossing of Arsenal Street. The corridor would travel through the campus and provide access to North Beacon Street, opposite Charles River Road. Both Kingsbury Avenue and Talcott Avenue are planned to include pedestrian and bicycle accommodations.
- **Arsenal Park Connector:** The Town of Watertown is working with LivableStreets Alliance to extend the existing spur of the Watertown-Cambridge Greenway from where it terminates at Arsenal Street next to the Watertown Mall through Arsenal Park and to North Beacon Street. Routing of the pathway is currently being developed.
- **Arsenal Yards:** Bicycle connections are being considered as part of the redevelopment of the Arsenal Mall site, including a potential mixed-use path to Greenough Boulevard.
- **Hanover/Elan Union Market:** An east-west pathway is being constructed on the north sides of these two developments to improve connectivity to the neighborhood. The pathway will connect to Birch Road and provides an opportunity to access Walnut Street and points north.

Providing cross connections between the Watertown Greenway/Arsenal Street and the Charles River has several positive public health effects. It improves pedestrian and bicycle connections among residential areas, employment centers, and the regional recreational trail systems. In doing so it encourages active transportation and promotes healthy living as an important aspect of healthy community design. In addition, it helps reduce automobile dependency and hence traffic congestion on and around Arsenal Street, and could result in fewer greenhouse gas emissions and transportation-related noise.

Analysis of Alternative 3 considered potential additional north-south connections west of Wooley Avenue to further improve access between the Charles River and residential neighborhoods both north and south of Arsenal Street. As shown in Figure 5-3, Irving Street, Beechwood Avenue, and Louise Street/Paul Street were considered as they each provide continuous connections between Arsenal Street and the river.

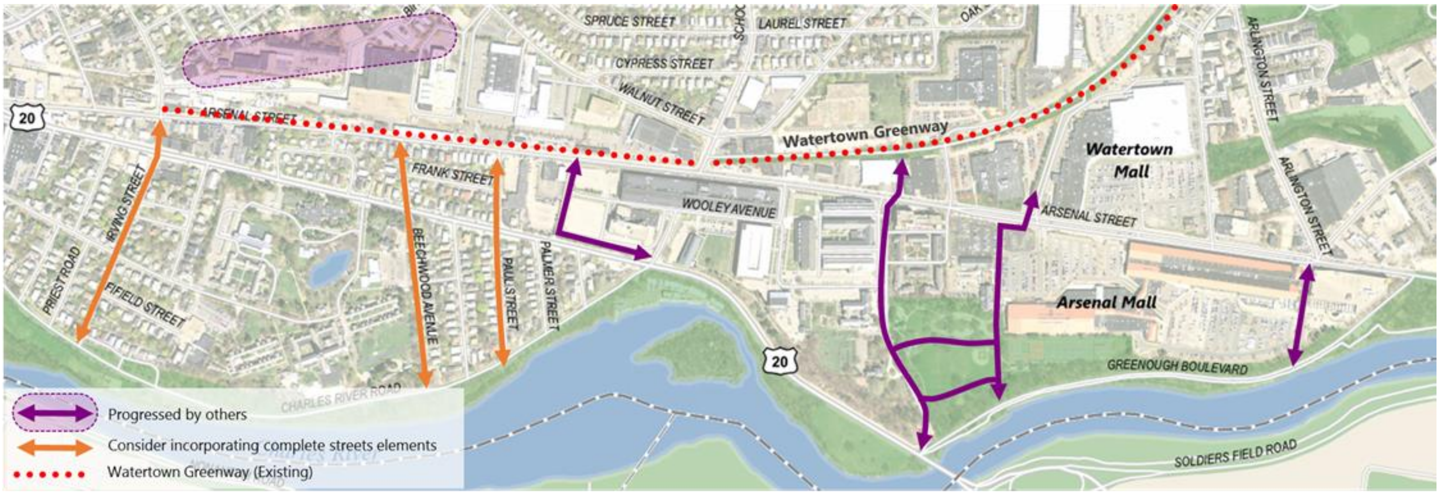
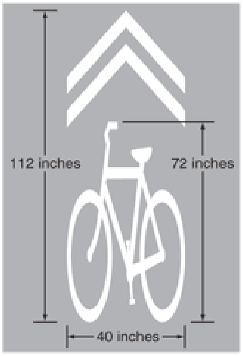


Figure 5-3 Alternative 3 Cross Connectivity between the Greenway and Charles River



Source: 2009 Manual on Uniform Traffic Control Devices

Shared lane markings ("sharrows") are pavement markings that indicate a shared environment for bicycles and motor vehicles and do not require additional roadway space. This type of treatment can be used to reinforce the legitimacy of bicycle traffic on a roadway and support a complete bikeway network.

Based on a review of the existing curb-to-curb width and an understanding of the limited right-of-way along all each of these roadways, installation of bike lanes would require potentially significant changes to traffic circulation patterns (such as the creation of one-way streets). Other Complete Streets elements, such as shared lane markings could be considered by the town to improve north-south connectivity and accommodated within the existing right-of-way.

Irving Street, Beechwood Avenue, and Louise Street/Paul Street were each reviewed to determine physical changes that would be needed to support striping formal bike lanes. It should be noted that for the purposes of this analysis, the back of sidewalk on each side of the street was assumed to be the right-of-way line. If any of the accommodations discussed below were progressed, field survey would be required to establish the right-of-way.

- **Irving Street:** The cross-sectional width of Irving Street varies from roughly 36 to 40 feet. This width is not sufficient to accommodate minimum travel lane widths, bicycle lanes, and sidewalks meeting ADA guidelines. Creation of a one-way street would be difficult for traffic circulation, as there is no nearby parallel route to serve traffic in the opposite direction. Therefore, shared lane markings were determined to be the most advantageous.
- **Beechwood Avenue:** The cross-sectional width of Beechwood Avenue varies from 37 to 40 feet. This width is not sufficient to accommodate minimal travel lane widths, bicycle lanes, and sidewalks meeting ADA guidelines. When also considering the adjacent Louise Street/Paul Street corridor, Beechwood Avenue may be a candidate to convert to one-way. Given the recent traffic signal changes at the intersection of Beechwood Avenue at Arsenal Street, one-way northbound may be beneficial, however further assessment of traffic flow patterns would be required if this option were to be considered. With the elimination of a travel lane, the roadway can accommodate a northbound

vehicular travel lane, northbound bike lane and a southbound contra-flow bike lane. Options such as separated bike lanes and shared use paths could also be considered but would likely not warrant the associated cost given the low traffic volume along the roadways. It is noted that the Perkins School for the Blind provides parking access via Beechwood Avenue. Travel patterns to/from this location would have to be carefully considered.

- **Louise Street/Paul Street:** The cross-sectional width along Louise and Paul Streets vary from 36 to 40 feet. As noted above, there is a possibility to convert Louise/Paul Street to one-way southbound in conjunction with Beechwood Avenue. Additional study of traffic circulation patterns is needed to understand potential localized impacts. The creation of on-road bike lanes provides a dedicated space for bicyclists who may live in the neighborhood or want to connect from the Watertown Greenway to the river. Specific to the one-way pair of Beechwood Avenue and Louise Street/Paul Street, Frank Street should also be included in the evaluation to determine the potential for impact.

Overall, traffic volumes on these roadways are low and speeds are moderate. Through the public informational meetings, residents within the neighborhood expressed frustration with respect to "cut-through" traffic. To the extent possible, any changes to bicycle accommodations should also include discussion of traffic calming measures to offset the potential for further impacts. Further community outreach is needed to develop specific recommendations within the neighborhood, with respect to possible one-way streets, shared lane markings and the potential to formalize crossing connections to the Paul Dudley White path across Charles River Road.

Final costs and the potential for environmental permitting for this alternative would be based on the outcome of this outreach. Based on aerial photographs and MassGIS data, the pathways at Charles River Road/Greenough Boulevard may be within jurisdictional resource areas and/or buffer zones associated with the Charles River and regulated under the Massachusetts Wetlands Protection Act (310 CMR 10.00) and the Watertown Wetlands Ordinance, thus requiring submission of a Notice of Intent (NOI) application. Depending on the type of connection made (if any), Alternative 3 could require the following wetlands resource related regulatory permits:

- Local/State – Order of Conditions from Watertown Conservation Commission
- Federal – National Pollution Discharge Elimination System (NPDES) Construction General Permit from U.S. Environmental Protection Agency (USEPA)

Table 5-2 considers the results of the analysis discussed above and summarizes the complete evaluation of Alternative 3 against the study goals and objectives. Cross-connectivity to the river is a short-term recommendation.

Table 5-2 Alternative 3 Evaluation and Recommendation

✓	Positive Impact
●	Neutral Impact
✖	Negative Impact
PHO	Public Health Objective

Goals	Objectives	Impact	Comments
Mobility Benefits	Decrease congestion and reduce delays (PHO)	●	1. Can be planned in a way that reduces potential for cut-through and improves streetscape. Care should be taken to avoid harmful property impacts.
	Improve system reliability	●	
	Minimize local street impacts	●[1]	
	Maintain emergency vehicle and first responder mobility	●	
Safety Improvements	Identify, eliminate, or mitigate locations and situations that pose hazards (PHO)	●	
	Address current design standard deficiencies (PHO)	●	
Accessibility and Connectivity Benefits	Reduce auto dependency (PHO)	✓	
	Improve existing public transportation services (PHO)	●	
	Coordinate existing transit services	●	
	Improve bike and pedestrian connections (PHO)	✓	
	Promote active transportation (PHO)	✓	
Economic Development Impacts	Support existing and projected economic development	●	2. Improves connectivity for those that may not have access to automobile or transit options.
	Minimize negative economic effects to tax bases; enhance local and regional economic activity	●	
	Improve non-motorized access and connectivity between business centers and employment centers (PHO)	✓	
	Improve access to the regional highway system	●	
	Avoid/minimize/mitigate social equity impacts	✓[2]	
	Incorporate healthy community design features (PHO)	✓	
Environmental Impacts	Support smart growth, anti-sprawl initiatives (PHO)	●	3. Potential environmental impacts in creating formalized connections to the pathways along Charles River Road/ Greenough Boulevard.
	Avoid/minimize/mitigate impacts to the natural environment	✖[3]	
	Minimize greenhouse gas emissions (PHO)	✓	
	Reduce CO and particulate matter impacts (PHO)	✓	
	Minimize transportation-related noise impacts along the corridor (PHO)	✓	
Lasting Benefits	Develop a range of multimodal recommendations that support ongoing changes and have lasting benefits	✓	
Public Support	Encourage consensus through an open and inclusive process	TBD	Requires further outreach.
Cost	Preliminary Order-of-Magnitude Construction Cost Estimate	N/A	Shared lane markings are roughly $150 each.[2]
Recommendation	***Continue to support paths being planned independent of this study. Advance the consideration of Complete Streets elements with additional community outreach.***		

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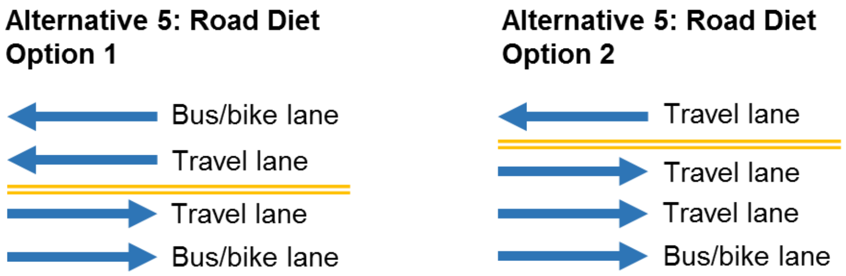
[2] Unit cost assumes thermoplastic shared lane markings.

Alternative 5: Road Diet East of School Street

Alternative 5 was further developed to improve multimodal conditions by considering a road diet for the four-lane section of Arsenal Street from east of School Street to Greenough Boulevard. Two potential road diet options were considered (Figure 5-4):

- Option 1: One general travel lane and one shared bus/bike lane in each direction
- Option 2: One general travel lane westbound and two general purpose and one shared bus/bike lanes eastbound

Under both options, the curb-to-curb width would not be modified.


Alternative 5: Road Diet Option 1

Alternative 5: Road Diet Option 2

Figure 5-4 **Alternative 5 Road Diet Schematics**

Analysis of Alternative 5 included a roadway capacity threshold evaluation and identification of potentially impacted parallel routes. The threshold evaluation established the approximate reduced capacity of Arsenal Street with a road diet implemented and compared that to the projected demand. The reduced capacity was established based on guidance in the 2010 HCM which states that the theoretical capacity of a two-lane highway is 3,200 vehicles per hour (in both directions). Assuming a 50 percent reduction in capacity for the presence of signals and other geometric conditions along the corridor, the assumed capacity was 1,600 vehicles per hour in both directions, or 800 vehicles per hour per lane. This capacity was compared to projected 2040 traffic volumes along several key segments of the corridor. The results of this comparison are presented in Table 5-3.

Table 5-3 Alternative 5 Roadway Capacity Threshold Analysis

Option 1 (Eastbound and Westbound Diversion)

Arsenal Street Segment	AM Peak Hour 2040 Volume	AM Peak Hour Diverted Traffic (Percent Diverted)	PM Peak Hour 2040 Volume	PM Peak Hour Diverted Traffic (Percent Diverted)
East of School Street				
EB	1,610	810 (50%)	845	45 (5%)
WB	500	n/a (n/a)	1,230	430 (35%)
East of Arsenal Project Main Driveway				
EB	1,040	240 (23%)	980	180 (18%)
WB	700	n/a (n/a)	880	80 (9%)
East of Arlington Street				
EB	1,480	680 (46%)	1,270	470 (37%)
WB	995	195 (20%)	1,085	285 (26%)

Option 2 (Westbound Diversion Only)

Arsenal Street Segment	AM Peak Hour 2040 Volume	AM Peak Hour Diverted Traffic (Percent Diverted)	PM Peak Hour 2040 Volume	PM Peak Hour Diverted Traffic (Percent Diverted)
East of School Street				
EB	1,610	0 (0%)	845	0 (0%)
WB	500	n/a (n/a)	1,230	430 (35%)
East of Arsenal Project Main Driveway				
EB	1,040	0 (0%)	980	0 (0%)
WB	700	n/a (n/a)	880	80 (9%)
East of Arlington Street				
EB	1,480	0 (0%)	1,270	0 (0%)
WB	995	195 (20%)	1,085	285 (26%)

n/a: Not applicable since the projected 2040 volume could be accommodated in one lane.

It should be noted that a review of turning movement counts indicates that a significant number of Arsenal Street trips have destinations within the segment being considered for a road diet. As such, achieving the diversions outlined in Table 5-3 to maintain acceptable traffic operations may not be feasible.

Analysis of Alternative 5 also included identification of parallel routes anticipated to be impacted if a road diet were implemented along Arsenal Street. Potential impacted parallel routes are shown in Figure 5-5.

To the south, the North Beacon Street, Greenough Boulevard, Soldiers Field Road, and Birmingham Parkway corridors would likely experience increased traffic volumes. There are limited options to travel between Arsenal Street and these southern parallel routes and increases to traffic in residential neighborhoods via Beechwood Avenue and Louise Street and/or through the athenahealth campus would be expected.

Diversion routes to the north are more limited and include Dexter Avenue, Nichols Avenue, Grove Street, and the local streets connecting these roadways.

While the road diet's potential to improve public transit service and encourage biking as alternative means of traveling could provide positive public health benefits along Arsenal Street, the diversion routes would bear the brunt of displaced traffic and related public health impacts.

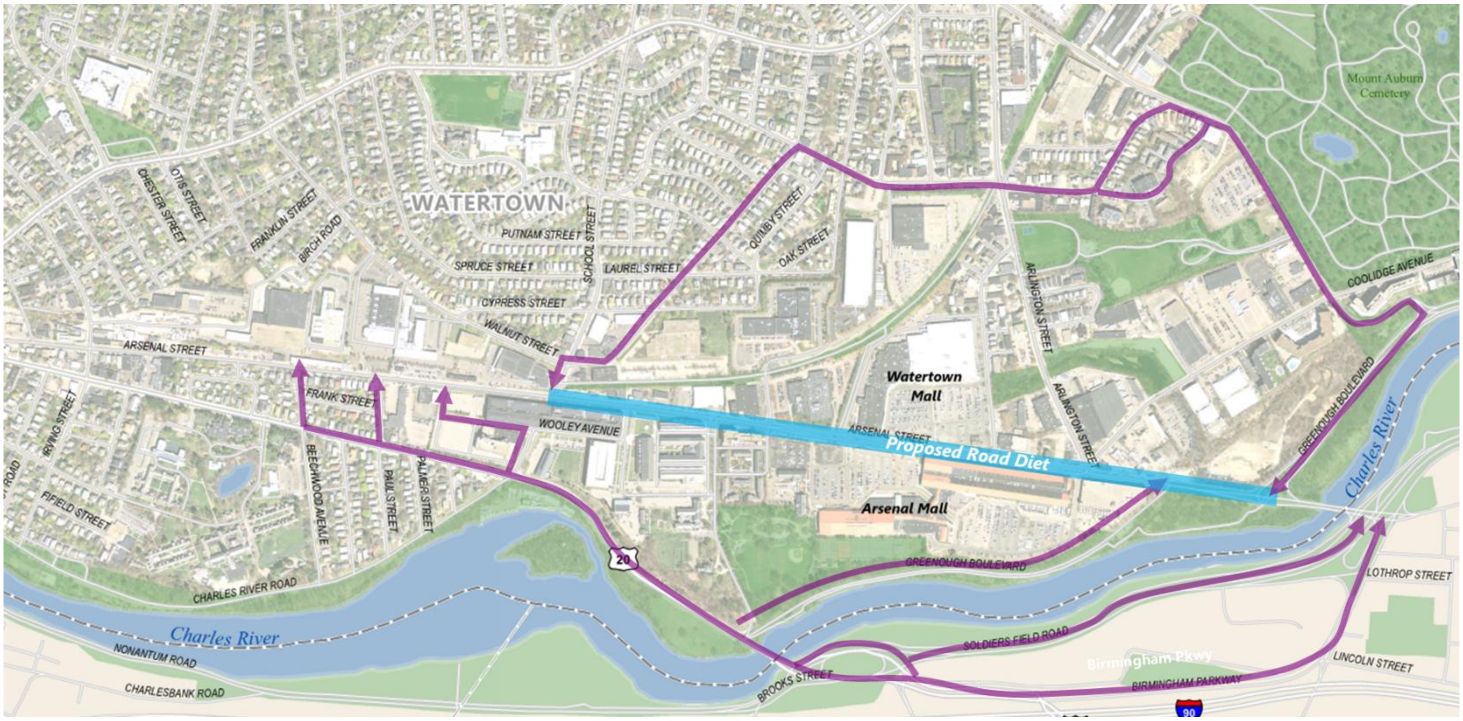


Figure 5-5 **Alternative 5 Potential Impacted Parallel Routes**

Table 5-4 considers the results of the analysis discussed above, summarizes the complete evaluation of Alternative 5 against the study goals and objectives. Due to severe impacts to mobility along Arsenal Street, including the potential to constrain access to several major employers, safety concerns related to bus/bike conflicts in the dedicated lane over a relatively short length, and the potential negative effects a reduced cross-section could have on economic development along the corridor, Alternative 5 is not recommended. Secondarily, there was concern expressed about the potential for traffic diversion related to this alternative, as the majority of diversion routes are primarily residential in nature and therefore less able to absorb levels of diversion while maintaining reliable access for residents.

Table 5-4 Alternative 5 Evaluation and Recommendation

✓	Positive Impact
●	Neutral Impact
✖	Negative Impact
PHO	Public Health Objective

Goals	**Objectives**	**Impact**	**Comments**
Mobility Benefits	Decrease congestion and reduce delays (PHO)	✖	1. While a road diet could improve transit operations on this section, the overall system reliability. would not markedly improve. 2. Increased Arsenal Street and neighborhood congestion may affect emergency response times.
	Improve system reliability	●[1]	
	Minimize local street impacts	✖	
	Maintain emergency vehicle and first responder mobility	✖[2]	
Safety Improvements	Identify, eliminate, or mitigate locations and situations that pose hazards (PHO)	●	
	Address current design standard deficiencies (PHO)	●	
Accessibility and Connectivity Benefits	Reduce auto dependency (PHO)	●[3]	3. Overall benefits would be noted within the area of the road diet only. Additional conflict points may be created in transition areas and sustained benefits would not be noted outside the project limits.
	Improve existing public transportation services (PHO)	✓[3]	
	Coordinate existing transit services	●[3]	
	Improve bike and pedestrian connections (PHO)	✓[3]	
	Promote active transportation (PHO)	✓[3]	
Economic Development Impacts	Support existing and projected economic development	✖[4]	4. Traffic diversions result in decreased visibility for Arsenal Street businesses. 5. Opportunity to improve landscaping.
	Minimize negative economic effects to tax bases; enhance local and regional economic activity	✖[4]	
	Improve non-motorized access and connectivity between business centers and employment centers (PHO)	✓	
	Improve access to the regional highway system	●	
	Avoid/minimize/mitigate social equity impacts	✓	
	Incorporate healthy community design features (PHO)	✓[5]	
Environmental Impacts	Support smart growth, anti-sprawl initiatives (PHO)	●	6. Traffic diversions result in longer trips and increased emissions; Arsenal Street congestion anticipated to increase.
	Avoid/minimize/mitigate impacts to the natural environment	●	
	Minimize greenhouse gas emissions (PHO)	✖[6]	
	Reduce CO and particulate matter impacts (PHO)	✖[6]	
	Minimize transportation-related noise impacts along the corridor (PHO)	●	
Lasting Benefits	Develop a range of multimodal recommendations that support ongoing changes and have lasting benefits	✖	
Public Support	Encourage consensus through an open and inclusive process	n/a	
Cost	Preliminary Order-of-Magnitude Construction Cost Estimate	n/a	Alternative 5 discarded.
Recommendation	***Discard Alternative 5 from consideration due severe impacts to Arsenal Street mobility and anticipated parallel route diversions.***		

Alternative 6: Soldiers Field Road Gateway Improvement

Alternative 6 considered options for the Soldiers Field Road gateway to improve operations and enhance safety. The original alternative included improvements along Arsenal Street from Soldiers Field Road at Birmingham Parkway through Arsenal Street at Coolidge Ave/Arlington Avenue. Due to ongoing development work and study near the intersection of Soldiers Field Road at Birmingham Parkway through the City of Boston, the project team was asked to refocus Alternative 6 on the area between Greenough Boulevard and Coolidge Avenue/Arlington Avenue. The refined alternative now considers two options to relocate the Coolidge Avenue approach to the intersection:

- **Option 1: Arlington Street Relocation -** Restricting access to the intersection from Coolidge Avenue and creating a new connection between Coolidge Avenue and Arlington Street (Figure 5-6). The new intersection of Arlington Street and Coolidge Avenue would be signalized.

  Several traffic control methods were considered for the new intersection. Based on capacity analysis results and safety concerns the best options were a roundabout or traffic signal. To limit the right-of-way impacts associated with the option, a traffic signal was preferred. Based on traffic projections with the roadway relocation, the peak hour traffic signal warrant would be met. Signal warrant evaluation and traffic signal operations would be further refined if the town chooses to advance this option. It is noted that a roundabout can be reconsidered if property impacts are not considered a concern.

- **Option 2: Arsenal Street Relocation -** Restricting access to the intersection from Coolidge Ave and creating a new connection between Coolidge Avenue and Arsenal Street (Figure 5-7). Coolidge Avenue would intersect Arsenal Street at a new, signalized intersection that would likely incorporate Greenough Boulevard South.

  Due to heavy traffic volumes and adjacent DCR lands and recreational trails, a traffic signal would be the preferred method of traffic control at this proposed location. For analysis purposes, it was assumed that Greenough Boulevard South would be included in the traffic signal if Option 2 is progressed and the intersection is signalized. Based on available data, the intersection meets the peak hour traffic signal warrant and would likely meet additional warrants. Signal warrant evaluation and traffic signal operations would be further refined if the town chooses to advance this option.

It should be noted that access to businesses along Coolidge Avenue would remain open under both improvement options and that both improvement options include modifications to the existing traffic signal phasing and timing (along with upgrading signal equipment) at the intersection of Arsenal Street and Arlington Street.

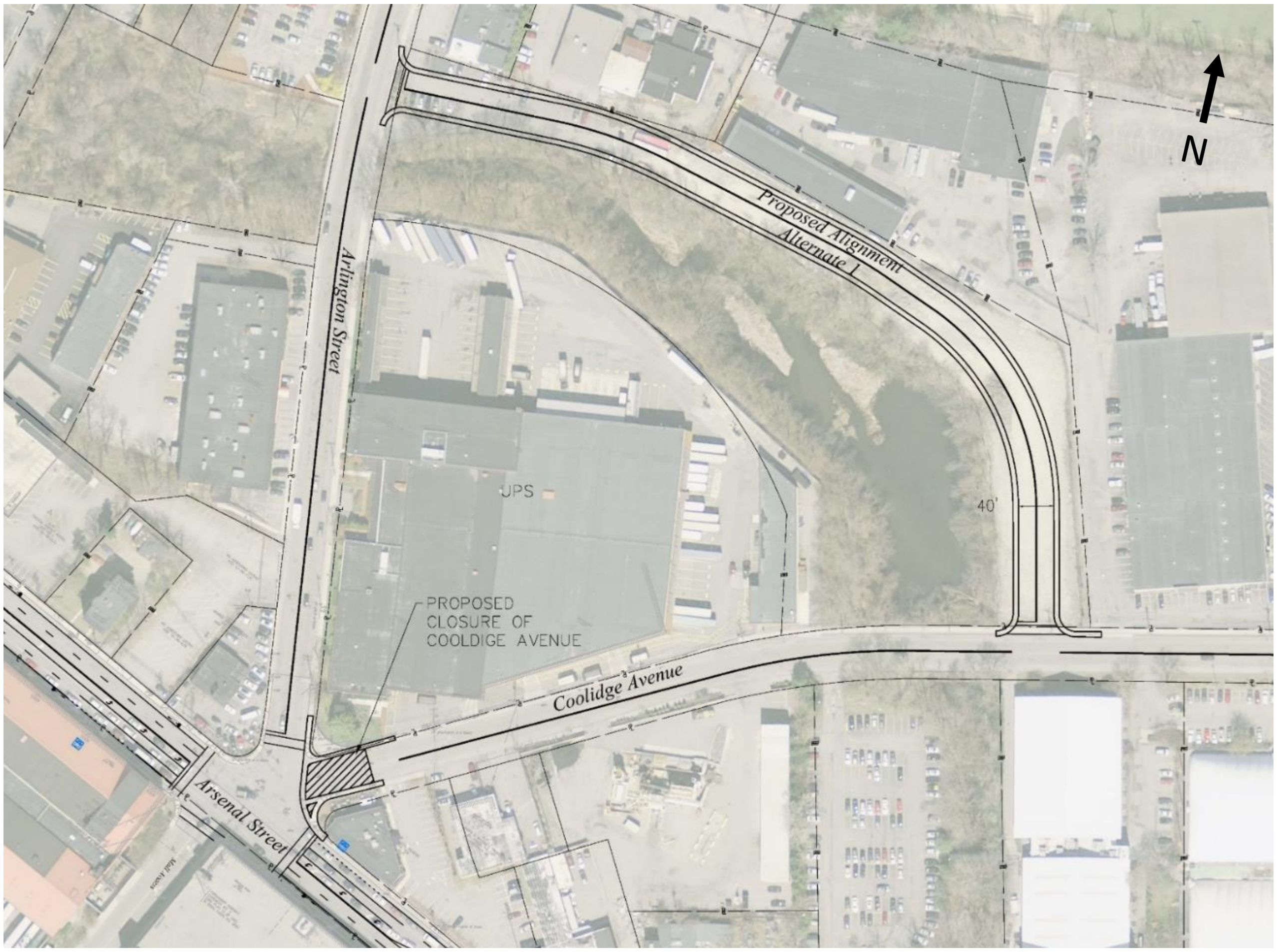


Figure 5-6 Option 1 Arsenal Street at Arlington Street/Coolidge Avenue Proposed Improvements

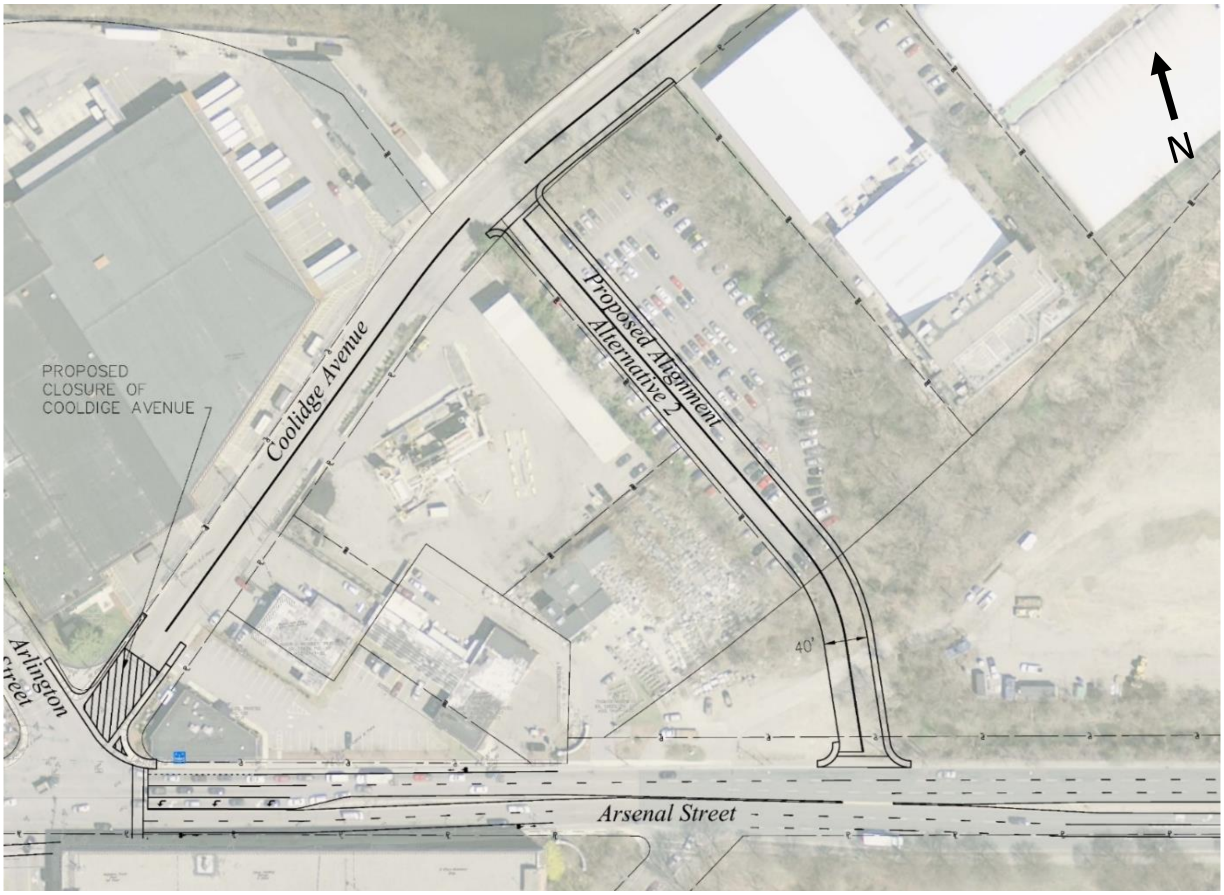


Figure 5-7 **Option 2 Arsenal Street at Arlington Street/Coolidge Avenue Proposed Improvements**

Alternative 6 represents a gateway entrance to the Arsenal Street Corridor and improvements that facilitate better traffic flow help support retail and other businesses that rely on drive-by traffic as a stimulant for their customer base (economic activity). These improvements also increase pedestrian safety and connectivity at the intersections and help mitigate potential safety hazards. Restriping the section of Arsenal Street between Arlington Street and Greenough Boulevard, which improves the lane alignment, will help enhance mobility and safety by reducing driver confusion. Collectively these incremental improvements can lead to enhanced public health and economic growth. However, preliminary concepts do include disrupting direct access to the businesses along this section of Arsenal Street and Coolidge Avenue, which may affect consumer and redevelopment opportunities.

Both options considered are in proximity to sensitive environmental resources and would require environmental permitting.

- Option 1, the relocation of Coolidge Avenue to the north, would be within jurisdictional resource areas and/or buffer zones associated with Sawins Pond and regulated under the WPA and the Watertown Wetlands Ordinance, thus requiring the filing of a NOI application.

- Option 2, the relocation of Coolidge Ave to the south, would be within jurisdictional resource areas and/or buffer zones associated with a perennial stream and requiring the filing of a NOI application.

Option 2 may also require additional permitting. A portion of the land where the alignment intersects with Arsenal Street previously belonged to the federal government and was recently transferred to DCR. As DCR is currently, and at this time independently, planning the next steps for the property, it is unclear what additional regulatory action may be required if this option was chosen to move forward.

Alternative 6 could require the following wetlands resource related regulatory permits:

- Local/State – Order of Conditions from Watertown Conservation Commission
- Federal –NPDES Construction General Permit from USEPA
- The potential for additional permitting related to the recent transfer of land from the federal government to DCR

Traffic Analysis

Evaluation of Alternative 6 included intersection capacity analysis of each option using Synchro 8 software. Evaluation criteria include, level of service (LOS), intersection delay, and queue length. Level of service is a qualitative measure that considers factors such as roadway geometry, speed, travel delay, freedom to maneuver, and safety. Level of service, ranging from A (best operating conditions) to F (worst operating conditions), provides an index to the operational qualities of a roadway segment or an intersection. Tables 5-5 and 5-6 summarize the capacity analysis results.

The results of the analysis indicate that regardless of the option chosen, relocating Coolidge Avenue has the potential to decrease overall intersection delay by at least 55 percent, with improved overall levels of service from LOS F to LOS D or better. If the town chooses to install traffic signals at the newly created intersections, the alternatives also allow for additional protected pedestrian crossing opportunities, although improvements to congestion may be more muted with the introduction of increased vehicle delay. The proposed improvements also provide enhanced intersection safety by altering lane use groupings and providing separate signal phasing for conflicting approaches and movements. While the data do not suggest the intersection is a high crash location, the alignment of Arlington Street, Coolidge Avenue, and the driveway to the rear entrance of the Arsenal Mall creates an awkward intersection geometry where it is difficult to establish who has the right-of-way. The proposed improvements simplify the geometry and allow for improved sight lines.

Table 5-5a Alternative 6: Option 1 Capacity Analysis Summary (Morning Peak Hour)

		2040 Future Conditions					2040 Future Conditions Option 1				
Movement		v/c[1]	Delay[2]	LOS[3]	50th Q[4]	95th Q[5]	v/c	Delay	LOS	50th Q	95th Q
Arsenal Street at Arlington Street/ Coolidge Ave/ Home Depot Driveway											
Arsenal Street	EB LT	0.76	71	E	137	217	0.93	94	F	111	#240
	EB TH-TH/RT	0.84	48	D	346	425	0.74	33	C	253	327
Arsenal Street	WB LT	0.69	80	F	77	#172	0.78	84	F	61	#150
	WB TH-TH/RT	>1.20	>120	F	~507	#695	0.97	54	D	298	#436
Home Depot Driveway	NB LT/TH	0.34	50	D	38	84	0.67	77	E	42	#106
	NB RT	0.26	4	A	0	20	0.28	9	A	0	42
Arlington Street	SEB LT	-	-	-	-	-	0.90	54	D	311	#435
	SEB LT/TH/RT	-	-	-	-	-	0.92	55	D	292	#422
	SEB LT/TH-TH/RT	>1.20dl	>120	F	~488	#584	-	-	-	-	-
Coolidge Avenue	SWB LT/TH-TH/RT	0.58	22	C	44	128	-	-	-	-	-
	Overall		**>120**	**F**				**50**	**D**		
Arlington Street at Coolidge Avenue Extension											
Coolidge Avenue	EB LT/TH/RT	-	-	-	-	-	0.03	14	B	3	14
Coolidge Avenue	WB LT/TH/RT	-	-	-	-	-	0.61	27	C	68	#136
Arlington Street	NB LT/TH/RT	-	-	-	-	-	0.51	7	A	76	140
Arlington Street	SB LT/TH/RT	-	-	-	-	-	0.80	17	B	187	#416
	Overall		**-**	**-**				**15**	**B**		

1 – volume to capacity ratio
2 – average delay in seconds per vehicle
3 – Level of Service
4 – 50th Percentile Queue, in feet
5 – 95th Percentile Queue, in feet
~ – 50th percentile volume exceeds capacity, queue may be longer
# - 95th Percentile volume exceeds capacity, queue may be longer
m - Volume for 95th Percentile queue is metered by upstream signal
EB = Eastbound, WB = Westbound; NB = Northbound; SB = Southbound; SEB = Southeastbound; SWB = Southwestbound
LT = Left-turn; TH = Through; RT = Right-turn

Table 5-5b Alternative 6: Option 1 Capacity Analysis Summary (Evening Peak Hour)

		2040 Future Conditions					2040 Future Conditions Option 1				
Movement		**v/c[1]**	**Delay[2]**	**LOS[3]**	**50th Q[4]**	**95th Q[5]**	**v/c**	**Delay**	**LOS**	**50th Q**	**95th Q**
Arsenal Street at Arlington Street/ Coolidge Ave/ Home Depot Driveway											
Arsenal Street	EB LT	0.74	70	E	127	204	0.81	72	E	101	#218
	EB TH-TH/RT	0.83	48	D	337	416	0.66	27	C	231	308
Arsenal Street	WB LT	0.72	81	F	82	#182	0.55	53	D	63	#122
	WB TH-TH/RT	>1.20	>120	F	~586	#778	0.86	35	C	311	#447
Home Depot Driveway	NB LT/TH	0.48	53	D	65	113	0.70	66	E	72	#129
	NB RT	0.37	11	B	8	48	0.27	7	A	0	33
Arlington Street	SEB LT	-	-	-	-	-	0.78	50	D	173	270
	SEB LT/TH/RT	-	-	-	-	-	0.71	41	D	142	234
	SEB LT/TH-TH/RT	0.52	42	D	153	220	-	-	-	-	-
Coolidge Avenue	SWB LT/TH-TH/RT	0.46	15	B	22	84	-	-	-	-	-
	Overall		**95**	**F**				**37**	**D**		
Arlington Street at Coolidge Avenue Extension											
Coolidge Avenue	EB LT/TH/RT	-	-	-	-	-	0.03	10	B	2	12
Coolidge Avenue	WB LT/TH/RT	-	-	-	-	-	0.37	15	B	39	83
Arlington Street	NB LT/TH/RT	-	-	-	-	-	0.59	12	B	100	182
Arlington Street	SB LT/TH/RT	-	-	-	-	-	0.48	11	B	85	147
	Overall		**-**	**-**				**12**	**B**		

1 – volume to capacity ratio
2 – average delay in seconds per vehicle
3 – Level of Service
4 – 50th Percentile Queue, in feet
5 – 95th Percentile Queue, in feet
~ – 50th percentile volume exceeds capacity, queue may be longer
# - 95th Percentile volume exceeds capacity, queue may be longer
m - Volume for 95th Percentile queue is metered by upstream signal
EB = Eastbound, WB = Westbound; NB = Northbound; SB = Southbound; SEB = Southeastbound; SWB = Southwestbound
LT = Left-turn; TH = Through; RT = Right-turn

Table 5-6a Alternative 6: Option 2 Capacity Analysis Summary (Morning Peak Hour)

		2040 Future Conditions					2040 Future Conditions Option 2				
Movement		**v/c[1]**	**Delay[2]**	**LOS[3]**	**50th Q[4]**	**95th Q[5]**	**v/c**	**Delay**	**LOS**	**50th Q**	**95th Q**
Arsenal Street at Arlington Street/ Coolidge Ave/ Home Depot Driveway											
Arsenal Street	EB LT	0.76	71	E	137	217	0.30	62	E	21	51
	EB TH-TH/RT	0.84	48	D	346	425	1.03	77	E	~453	#590
Arsenal Street	WB LT	0.69	80	F	77	#172	0.49	57	E	96	m122
	WB TH-TH/RT	>1.20	>120	F	~507	#695	0.74	38	D	287	#541
Home Depot Driveway	NB LT/TH	0.34	50	D	38	84	0.68	94	F	43	#107
	NB RT	0.26	4	A	0	20	0.26	9	A	0	48
Arlington Street	SEB LT	-	-	-	-	-	0.72	40	D	310	350
	SEB LT/TH/RT	-	-	-	-	-	0.72	40	D	306	347
	SEB LT/TH-TH/RT	>1.20dl	>120	F	~488	#584	-	-	-	-	-
Coolidge Avenue	SWB LT/TH-TH/RT	0.58	22	C	44	128	-	-	-	-	-
	Overall		**>120**	**F**				**52**	**D**		
Arsenal Street at Coolidge Avenue Extension/Greenough Boulevard South											
Arsenal Street	EB LT	-	-	-	-	-	0.84	37	D	99	m133
	EB TH-TH/RT	-	-	-	-	-	0.66	11	B	186	m299
Arsenal Street	WB LT/TH-TH/RT	-	-	-	-	-	0.85	31	C	353	467
Greenough Boulevard	NB LT/TH/RT	-	-	-	-	-	0.77	54	D	142	#270
Coolidge Street	SB LT/TH/RT	-	-	-	-	-	0.49	23	C	70	149
	Overall		**-**	**-**				**23**	**C**		

1 – volume to capacity ratio
2 – average delay in seconds per vehicle
3 – Level of Service
4 – 50th Percentile Queue, in feet
5 – 95th Percentile Queue, in feet
~ – 50th percentile volume exceeds capacity, queue may be longer
# - 95th Percentile volume exceeds capacity, queue may be longer
m - Volume for 95th Percentile queue is metered by upstream signal
EB = Eastbound, WB = Westbound; NB = Northbound; SB = Southbound; SEB = Southeastbound; SWB = Southwestbound
LT = Left-turn; TH = Through; RT = Right-turn

Table 5-6b Alternative 6: Option 2 Capacity Analysis Summary (Evening Peak Hour)

		2040 Future Conditions					2040 Future Conditions Option 2				
Movement		**v/c[1]**	**Delay[2]**	**LOS[3]**	**50th Q[4]**	**95th Q[5]**	**v/c**	**Delay**	**LOS**	**50th Q**	**95th Q**
Arsenal Street at Arlington Street/ Coolidge Ave/ Home Depot Driveway											
Arsenal Street	EB LT	0.74	70	E	127	204	0.39	54	D	34	71
	EB TH-TH/RT	0.83	48	D	337	416	0.92	50	D	337	#465
Arsenal Street	WB LT	0.72	81	F	82	#182	0.29	49	D	78	m108
	WB TH-TH/RT	>1.20	>120	F	~586	#778	0.71	20	B	156	#542
Home Depot Driveway	NB LT/TH	0.48	53	D	65	113	0.49	53	D	60	97
	NB RT	0.37	11	B	8	48	0.23	5	A	0	31
Arlington Street	SEB LT	-	-	-	-	-	0.74	56	E	148	218
	SEB LT/TH/RT	-	-	-	-	-	0.71	52	D	137	206
	SEB LT/TH-TH/RT	0.52	42	D	153	220	-	-	-	-	-
Coolidge Avenue	SWB LT/TH-TH/RT	0.46	15	B	22	84	-	-	-	-	-
	Overall		**95**	**F**				**37**	**D**		
Arsenal Street at Coolidge Avenue Extension/Greenough Boulevard South											
Arsenal Street	EB LT	-	-	-	-	-	0.56	18	B	40	m64
	EB TH-TH/RT	-	-	-	-	-	0.53	7	A	136	m149
Arsenal Street	WB LT/TH-TH/RT	-	-	-	-	-	0.79	18	B	272	373
Greenough Boulevard	NB LT/TH/RT	-	-	-	-	-	0.67	47	D	93	#182
Coolidge Street	SB LT/TH/RT	-	-	-	-	-	0.45	18	B	34	99
	Overall		**-**	**-**				**15**	**B**		

1 – volume to capacity ratio
2 – average delay in seconds per vehicle
3 – Level of Service
4 – 50th Percentile Queue, in feet
5 – 95th Percentile Queue, in feet
~ – 50th percentile volume exceeds capacity, queue may be longer
# - 95th Percentile volume exceeds capacity, queue may be longer
m - Volume for 95th Percentile queue is metered by upstream signal
EB = Eastbound, WB = Westbound; NB = Northbound; SB = Southbound; SEB = Southeastbound; SWB = Southwestbound
LT = Left-turn; TH = Through; RT = Right-turn

Table 5-7 considers the results of the analysis discussed above, summarizes the complete evaluation of Alternative 6 against the study goals and objectives, and provides a preliminary order-of-magnitude construction cost estimate. Intersection improvements at Arsenal Street and Arlington/Grove Street, along with modified striping to extend bicycle lanes to Greenough Boulevard North are long-term recommendations. As will be discussed in Chapter 6, there are short and medium term action items associated with developing these improvements further.

Table 5-7 Alternative 6 Evaluation and Recommendation

✓	Positive Impact
●	Neutral Impact
✖	Negative Impact
PHO	Public Health Objective

Goals	Objectives	Impact	Comments
Mobility Benefits	Decrease congestion and reduce delays (PHO)	✓	1. Benefits offset by the installation of new traffic signals. 2. May have potential to slightly alter emergency response times to/from Mount Auburn Hospital. Design can consider mountable curb for emergency access.
	Improve system reliability	●[1]	
	Minimize local street impacts	●[1]	
	Maintain emergency vehicle and first responder mobility	●[2]	
Safety Improvements	Identify, eliminate, or mitigate locations and situations that pose hazards (PHO)	✓[3]	3. Eliminating Coolidge Avenue at the intersection improves geometry and reduces vehicle conflicts.
	Address current design standard deficiencies (PHO)	✓	
Accessibility and Connectivity Benefits	Reduce auto dependency (PHO)	●	4. Benefits may be offset by the installation of new traffic signals.
	Improve existing public transportation services (PHO)	●[4]	
	Coordinate existing transit services	●	
	Improve bike and pedestrian connections (PHO)	✓	
	Promote active transportation (PHO)	✓	
Economic Development Impacts	Support existing and projected economic development	✓	
	Minimize negative economic effects to tax bases; enhance local and regional economic activity	✓	
	Improve non-motorized access and connectivity between business centers and employment centers (PHO)	●	
	Improve access to the regional highway system	●	
	Avoid/minimize/mitigate social equity impacts	●	
	Incorporate healthy community design features (PHO)	●	
Environmental Impacts	Support smart growth, anti-sprawl initiatives (PHO)	●	5. May require extensive environmental permitting. 6. Benefits offset by installation of new traffic signals.
	Avoid/minimize/mitigate impacts to the natural environment	✖[5]	
	Minimize greenhouse gas emissions (PHO)	●	
	Reduce CO and particulate matter impacts (PHO)	●[6]	
	Minimize transportation-related noise impacts along the corridor (PHO)	●	
Lasting Benefits	Develop a range of multimodal recommendations that support ongoing changes and have lasting benefits	✓	
Public Support	Encourage consensus through an open and inclusive process	TBD	Requires further outreach.
Cost	Preliminary Order-of-Magnitude Construction Cost Estimate	$1.5 – 2M	Cost dependent on option selected.
Recommendation	***Facilitate outreach to affected stakeholders are further refine concepts to determine whether a preferred alternative can be progressed.***		

Alternative 7: Watertown Square Gateway Improvements

Alternative 7 considers improvements to operations and safety for the Watertown Square gateway. The intersections included under this alternative are (1) Arsenal Street/Main Street at Mt. Auburn Street/Galen Street/Charles River Road and (2) Galen Street at Watertown Street/Nonantum Road.

The findings of the recently completed RSA at Galen Street and Watertown Street were considered when determining improvement options for the Watertown Square gateway. The RSA proposed vehicle phasing changes, incorporation of a flashing yellow arrow, and increased pedestrian clearance intervals. The improvement options include:

- Signal timing/phasing modifications
- Improved coordination between the intersections on either side of the river
- Intersection geometry (lane usage)
- Pedestrian accommodation enhancements
- Overhead (mast arm) wayfinding signage along all approaches
- The potential to relocate Charles River Road

A conceptual rendering of the proposed improvements is shown in Figure 5-8.

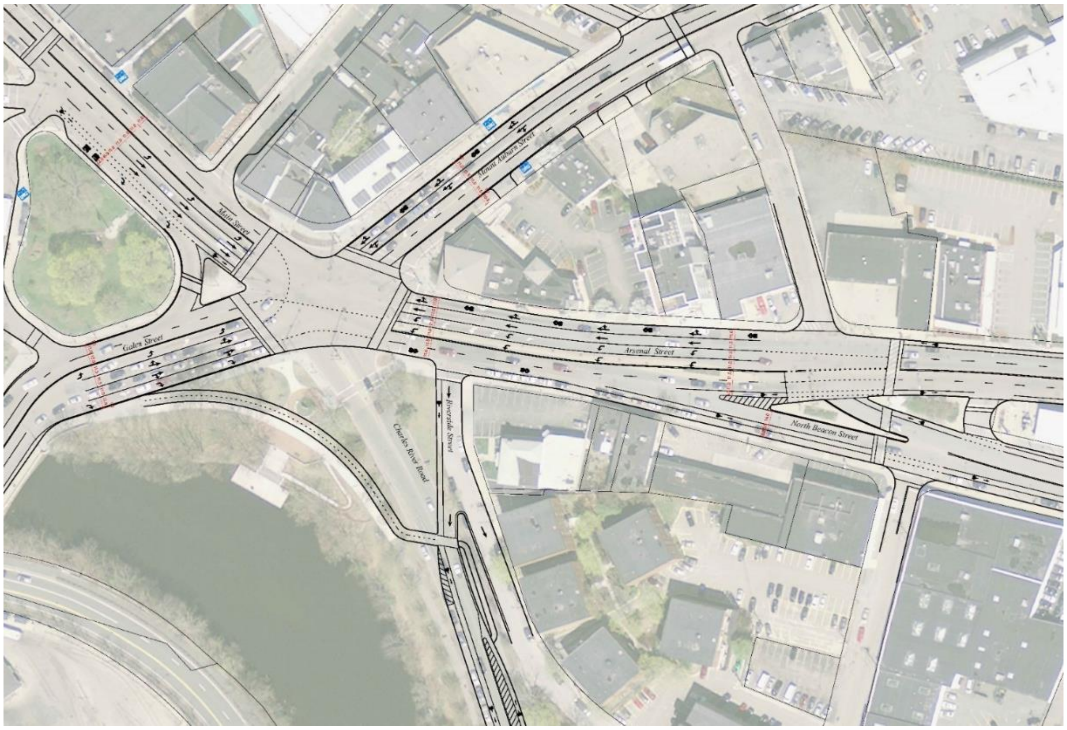


Figure 5-8 Conceptual Rendering of Watertown Square Proposed Improvements

The concept represents the first step in an iterative design development process. It is expected that specific, targeted public outreach would continue to shape and enhance this alternative as it is further developed. Through the Working Group process, there was discussion of additional shared-use paths through the newly created park land on the south side of the intersection, the need for a more refined look at "cut-through" traffic in the neighborhood adjacent to Charles River Road, and the potential to add an eastbound bus stop immediately east of Riverside Street. There was also significant discussion of landscaping opportunities along the new open spaces created by the discontinuance of Charles River Road.

The reconstruction of Watertown Square would include enhanced wayfinding by providing lane designation signage on traffic signal mast arms and considering pedestrian scale wayfinding directing users to various trails, the fishing pier, Perkins School, the Mosesian Center for the Arts and other area attractions. It also includes the potential to reintroduce a Route 70/70A bus stop adjacent to the Route 71 bus terminus. This stop has been previously relocated to the west due to traffic congestion. However, by removing a direct link between the two routes, transit connections have become more difficult and pedestrians are unable to see whether they are about to miss a connecting bus. Restoring the bus stop on the far side of the intersection does have some challenges, given existing levels of congestion, but would elevate the importance of a transit connection over facilitating traffic flow, a key consideration in the town's continued work in reestablishing placemaking throughout Watertown Square.

A common criticism raised by several members of the Working Group and at public meetings is the difficulty for cross connectivity on the bridge itself, both north/south and east/west. It was noted that many pedestrians are making bus connections between Watertown Square and Watertown Yard and/or the Charles River Greenway. These connections are currently achieved by pedestrians crossing outside of designated crosswalks and through traffic or vehicles queued at each of the traffic signals. The analysis of this alternative included a qualitative look at landscape features that may help improve or channelize pedestrian connectivity as part of this alternative. As the concept is further refined, there are several opportunities for landscaping along the areas adjacent to Watertown Square. As the open space transitions over the river towards Watertown Yard, there is less of an opportunity for improved landscaping, as the area narrows significantly and is needed for sidewalks of adequate width.

Enhanced pedestrian opportunities are created with the discontinuance of Charles River Road. Should this change be realized, and the MBTA amenable, an additional bus stop at Riverside Street would allow for a connection between the Route 70/70A bus and Watertown Yard which does not require crossing from one side of the bridge to the other. This potential expansion of parkland would create additional green space along the Charles River Greenway, which promotes healthy community design and supports active outdoor living.

Improved pedestrian crossings may also be created by modifications to the crash protection on the bridge itself. Removing the jersey barriers currently lining the bridge for crash protection (the decorative, historic railing along the river is not sufficient protection in the event of a vehicular crash where the vehicle may leave the roadway) and replacing them with ornamental crash-rated fencing can improve aesthetics over the bridge and channelize pedestrians towards designated crossing locations.

The discontinuance/relocation of Charles River Road would require coordination with DCR and may impact parkland along the Charles River. Impacts to DCR land would require the filing of a MEPA Environmental Notification Form (ENF) and a release of this land through the Article 97 state legislative process. It is anticipated that any impacts could be offset by the expansion of parkland within the existing Charles River Road alignment, increasing overall green space adjacent to the river path.

Based on aerial photographs and MassGIS data, Alternative 7 would impact jurisdictional resource areas and/or buffer zones associated with the Charles River and regulated under the WPA and the Watertown Wetlands Ordinance, thus requiring the filing of a NOI application.

Alternative 7 would require the following wetlands resource related regulatory permits:

- Local/State – Order of Conditions from Watertown Conservation Commission, MEPA ENF, and Conformance with EEA Article 97 Land Disposition Policy
- Federal –NPDES Construction General Permit from USEPA

Traffic Analysis

Analysis for this alternative included an intersection capacity analysis using Synchro 8 software to evaluate the improvement options impacts. For signalized intersections, the evaluation criteria include level of service, intersection delay, and queue length. Table 5-8 and 5-9 summarizes the capacity analysis results.

The proposed improvements positively benefit the intersection operations, along with improving safety, by altering lane use groupings, modifying traffic signal phasing, shortening pedestrian crossings and eliminating the Charles River Road approach to the intersection (traffic destined to Charles River Road would use Riverside Street). Operations at the signalized intersection for morning and evening peak hours experience a least a 40 percent decrease in overall delay with improved overall intersections from LOS F to LOS E or better. The improved traffic operations are primarily generated from the elimination of Charles River Road, with the total number of traffic signal phases being reduced from five to four.

While the traffic analysis focuses more specifically on the north side of the river, decreased congestion and delays are expected on both sides of the river, thereby reducing greenhouse gas emissions and improving public transit services. The proposed improvements also help mitigate safety hazards at the intersections by reducing driver confusion and improving mobility for all roadway users. The recommended pedestrian enhancements at Watertown Square and Watertown Street/Nonantum Road at Galen Street will enhance pedestrian safety and connections at these locations, promoting healthy and active transportation while improving multimodal access in the area and to recreational river uses.

Table 5-8 Alternative 7 Capacity Analysis Summary (Morning Peak Hour)

		2040 Future Conditions					2040 Future Conditions with Proposed Improvements				
Movement		**v/c[1]**	**Delay[2]**	**LOS[3]**	**50th Q[4]**	**95th Q[5]**	**v/c**	**Delay**	**LOS**	**50th Q**	**95th Q**
Galen Street/Mount Auburn Street & Charles River Road at Main Street/Arsenal Street											
Main Street	EB LT	0.32	45	D	73	129	0.68	86	F	105	167
	EB TH	1.17	>120	F	~452	#584	0.96	74	E	475	#619
	EB RT	1.03	73	E	~319	#549	0.82	23	C	163	347
Arsenal Street	WB LT	0.86	72	E	222	#375	0.86	84	F	184	#255
	WB TH-TH/RT	0.72	48	D	225	291	0.71	51	D	352	452
Galen Street	NB LT	0.64	55	E	122	m155	0.68	65	E	257	m318
	NB TH-TH/RT	>1.20dl	>120	F	~526	m#598	-	-	-	-	-
	NB LT/TH-TH/RT	-	-	-	-	-	0.96	81	F	380	m#481
	NB RT	-	-	-	-	-	0.91	84	F	318	m#449
Mount Auburn Street	SB LT	0.48	36	D	58	103	-	-	-	-	-
	SB TH-TH/RT	1.09	115	F	~291	#413	1.01	109	F	~392	#534
Charles River Road	NWB LT/TH/RT	>1.20	>120	F	~280	#448	-	-	-	-	-
	Overall		**>120**	**F**				**71**	**E**		
Galen Street at Watertown Street/Nonantum Road											
Watertown Street	EB LT	0.55	35	C	214	310	1.01	103	F	~254	#429
	EB TH/RT	>1.20	>120	F	~576	#791	0.64	39	D	383	513
Nonantum Road	WB LT/TH-TH/RT	>1.20	>120	F	~378	#498	0.97	80	F	307	#444
Galen Street	NB TH-TH/RT	0.47	23	C	209	263	0.50	32	C	276	336
Galen Street	SB LT/TH-TH	0.75	48	D	443	m431	0.79	25	C	209	m331
	SB RT	0.31	1	A	4	m3	0.34	1	A	7	m13
	Overall		**>120**	**F**				**42**	**D**		

1 – volume to capacity ratio
2 – average delay in seconds per vehicle
3 – Level of Service
4 – 50th Percentile Queue, in feet
5 – 95th Percentile Queue, in feet
~ – 50th percentile volume exceeds capacity, queue may be longer
# - 95th Percentile volume exceeds capacity, queue may be longer
m - Volume for 95th Percentile queue is metered by upstream signal
EB = Eastbound, WB = Westbound; NB = Northbound; SB = Southbound; NWB = Northwestbound
LT = Left-turn; TH = Through; RT = Right-turn

Table 5-9 Alternative 7 Capacity Analysis Summary (Evening Peak Hour)

		2040 Future Conditions					2040 Future Conditions with Proposed Improvements				
Movement		**v/c[1]**	**Delay[2]**	**LOS[3]**	**50th Q[4]**	**95th Q[5]**	**v/c**	**Delay**	**LOS**	**50th Q**	**95th Q**
Galen Street/Mount Auburn Street & Charles River Road at Main Street/Arsenal Street											
Main Street	EB LT	0.43	47	D	101	167	0.74	76	E	116	186
	EB TH	0.79	51	D	251	322	0.98	73	E	359	#498
	EB RT	>1.20	>120	F	~543	#774	0.64	10	A	17	120
Arsenal Street	WB LT	1.19	>120	F	~375	#573	0.94	86	F	251	#359
	WB TH-TH/RT	0.98	73	E	328	#464	0.91	54	D	421	#582
Galen Street	NB LT	0.95	87	F	186	m#275	0.94	77	E	291	m#428
	NB TH-TH/RT	>1.20	>120	F	~438	m#553	-	-	-	-	-
	NB LT/TH-TH/RT	-	-	-	-	-	0.99	77	E	320	m#428
	NB RT	-	-	-	-	-	0.95	80	E	262	m#395
Mount Auburn Street	SB LT	0.29	31	C	34	68	-	-	-	-	-
	SB TH-TH/RT	0.96	78	F	227	#343	1.02	92	F	~281	#404
Charles River Road	NWB LT/TH/RT	>1.20	>120	F	~316	#522	-	-	-	-	-
	Overall		**119**	**F**				**68**	**E**		
Galen Street at Watertown Street/Nonantum Road											
Watertown Street	EB LT	0.55	33	C	247	355	0.94	74	E	230	#440
	EB TH/RT	>1.20	>120	F	~619	#837	0.65	33	C	335	465
Nonantum Road	WB LT/TH-TH/RT	>1.20	>120	F	~321	#437	0.92	67	E	225	#346
Galen Street	NB TH-TH/RT	065	33	C	296	371	0.71	40	D	339	422
Galen Street	SB LT/TH-TH	0.73	36	D	407	m304	0.79	20	C	262	m#355
	SB RT	0.49	2	A	42	m24	0.52	3	A	60	m80
	Overall		**107**	**F**				**36**	**D**		

1 – volume to capacity ratio
2 – average delay in seconds per vehicle
3 – Level of Service
4 – 50th Percentile Queue, in feet
5 – 95th Percentile Queue, in feet
~ – 50th percentile volume exceeds capacity, queue may be longer
# - 95th Percentile volume exceeds capacity, queue may be longer
m - Volume for 95th Percentile queue is metered by upstream signal
EB = Eastbound, WB = Westbound; NB = Northbound; SB = Southbound; NWB = Northwestbound
LT = Left-turn; TH = Through; RT = Right-turn

Table 5-10 considers the results of the analysis discussed above, summarizes the complete evaluation of Alternative 7 against the study goals and objectives, and provides a preliminary order-of-magnitude construction cost estimate. Improvements to Watertown Square are medium-term recommendations. It is noted that the selection of certain funding sources (such as Transportation Improvement Program funding) may delay construction of the project to the long-term due to availability of funds.

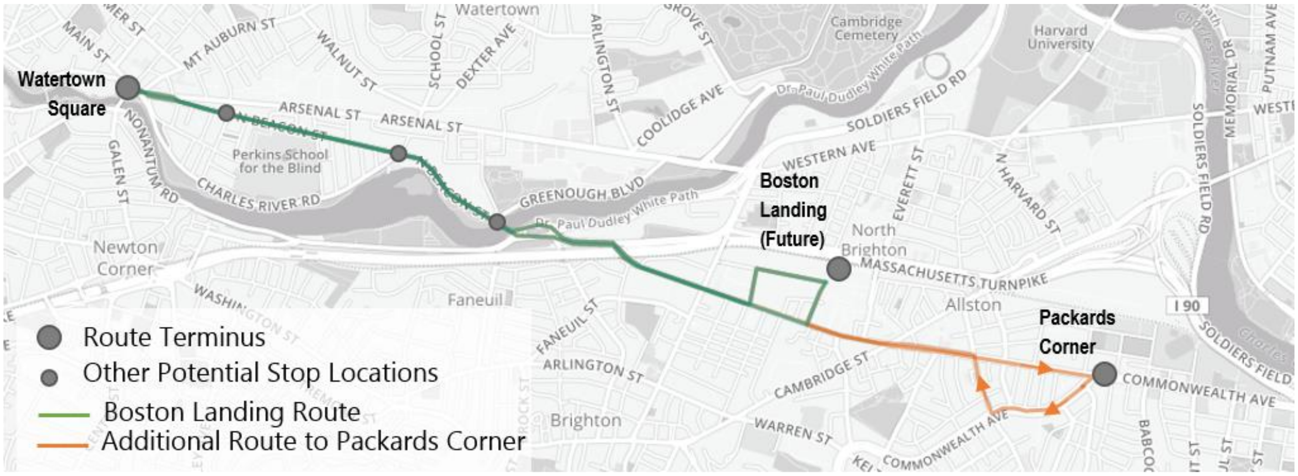
Table 5-10 Alternative 7 Evaluation and Recommendation

✓ ● ✗ *PHO*	Positive Impact Neutral Impact Negative Impact Public Health Objective

Goals	Objectives	Impact	Comments
Mobility Benefits	Decrease congestion and reduce delays (PHO)	✓	
	Improve system reliability	✓	
	Minimize local street impacts	●	
	Maintain emergency vehicle and first responder mobility	✓	
Safety Improvements	Identify, eliminate, or mitigate locations and situations that pose hazards (PHO)	✓1	1. Addresses several noted safety deficiencies.
	Address current design standard deficiencies (PHO)	✓1	
Accessibility and Connectivity Benefits	Reduce auto dependency (PHO)	●	2. Directly links existing bus routes. 3. Considers additional dedicated accommodations. 4. Combined with other improvements, may further promote active transportation.
	Improve existing public transportation services (PHO)	✓2	
	Coordinate existing transit services	✓2	
	Improve bike and pedestrian connections (PHO)	✓3	
	Promote active transportation (PHO)	●4	
Economic Development Impacts	Support existing and projected economic development	✓	5. Reduced congestion has the potential to improve consumer drive-by experience, but is not expected to noticeably enhance economic activity as a result of this alternative. Collectively, incremental improvements would minimize negative effects and enhance economic activity.
	Minimize negative economic effects to tax bases; enhance local and regional economic activity	●5	
	Improve non-motorized access and connectivity between business centers and employment centers (PHO)	●	
	Improve access to the regional highway system	✓	
	Avoid/minimize/mitigate social equity impacts	●	
	Incorporate healthy community design features (PHO)	✓	
Environmental Impacts	Support smart growth, anti-sprawl initiatives (PHO)	●	6. Requires environmental permitting.
	Avoid/minimize/mitigate impacts to the natural environment	✗6	
	Minimize greenhouse gas emissions (PHO)	✓	
	Reduce CO and particulate matter impacts (PHO)	✓	
	Minimize transportation-related noise impacts along the corridor (PHO)	✓	
Lasting Benefits	Develop a range of multimodal recommendations that support ongoing changes and have lasting benefits	✓	
Public Support	Encourage consensus through an open and inclusive process	TBD	Requires further outreach.
Cost	Preliminary Order-of-Magnitude Construction Cost Estimate	$1.5M	
Recommendation	***Progress concept plan through design development, focusing on additional public outreach and securing project funding***		

Alternative 10: Express Bus along North Beacon Street

Alternative 10 considers supplementing the existing MBTA Route 70/70A service with express bus service along North Beacon Street to improve connections between Watertown and Boston. The route would begin in Watertown Square and travel east along North Beacon Street. As this alternative was refined, two route termini to the east were considered: the future Boston Landing MBTA Commuter Rail station (anticipated opening Spring 2017 with access to South Station) and Packards Corner on the MBTA Green Line "B" branch (access to Copley Square/Park Street), as shown in Figure 5-9. Figure 5-9 also show potential stop locations. It is envisioned that the service would have limited stops (i.e., at only one or two of the potential locations shown).



Source: MBTA, using Remix software. Modified to add potential stop locations

Figure 5-9 Alternative 10 Express Bus Routes

Analysis of this alternative included an evaluation of ridership potential and preliminary estimates of travel times, service headways, and the number of buses required to run the service.

Journey to work data[31] were reviewed to estimate the number of commuters from East Watertown to Allston/Brighton, the Boston Core, and the South Boston Waterfront who may use the express bus service. An estimate of non-work based trips was also included. The data reviewed were collected from 2006 to 2010, before significant growth in the South Boston Waterfront had materialized. Therefore, the results of this evaluation for trips to this area should be considered conservative.

A review of commuting data indicates that the service could draw a minimum of 50 to 60 riders during the peak hours. Based on the data available, the majority of potential express bus riders would be destined for the Boston Core; however potential future commuting trips to South Boston Waterfront could increase these preliminary estimates. Ridership estimates are included in the Appendix.

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[31] U.S. Census Bureau, American Community Survey 2006-2010 Five-year estimates.

Working with the MBTA, an evaluation of potential peak period cycle times along both route options based on a combination of Google Maps travel time data and a cursory review of Route 57 and 64 segment run times was conducted. The shorter route is approximately 2.5 miles from Watertown Square to Boston Landing. One-way travel time during peak commuter periods is estimated to be 20 minutes (total route cycle time is 40 minutes). It should be noted that for this type of express bus service to be effective scheduling would need to be closely coordinated with the Boston Landing MBTA Commuter Rail to ensure an efficient transfer time between the services. While the Boson Landing schedule is not currently available, considering the estimated cycle time and coordination needs, it is anticipated that a minimum of two buses would be required to operate express bus service from Watertown Square to Boston Landing (assuming a planning capacity of 40 passengers per bus).

It should be noted that existing MBTA resource constraints preclude implementation of this service in the short-term without shifting resources from other routes. Based on the route termini and anticipated service parameters, the express bus is not expected to divert significant ridership from Routes 70/70A. However, if this alternative is advanced further, a more detailed evaluation of diversion potential from Routes 70/70A and/or other MBTA express buses using origin-destination-transfer (ODX) data should be conducted to determine if a shift in resources from those services to the North Beacon Street express bus is feasible. Alternatively, implementation of the express bus service as a shuttle by another provider (e.g., Watertown Transportation Management Association or a private entity) could be pursued. A pilot shuttle could help evaluate the service and demonstrate a shift from other MBTA services, enabling justification of a permanent shift of MBTA resources to this service.

Extending service from Boston Landing to Packards Corner was also considered. This extension adds approximately 1.6 miles and up to 22 minutes to the cycle time due to the peak period congestion along Brighton Avenue, Commonwealth Avenue, and Harvard Avenue. Given this increase in cycle time and the continued need to coordinate schedules with Boston Landing, extension of express bus service to Packards Corner is not recommended at this time. However, if service to Boston Landing is successful, extension of the route to Packards Corner or other major transit nodes (e.g., West Station, Longwood, Back Bay, etc.) could be considered.

Additional transit service options along North Beacon Street would enhance existing public transportation services and facilitate reduced auto dependency. The mode shift will likely result in reduced greenhouse gas emissions associated with automobile travel, although the environmental benefits may not be significant considering additional bus emissions. Regardless, and although the new transit service would not serve Arsenal Street directly, additional public transit options contribute to the public health vitality of the Arsenal Street corridor.

Table 5-11 considers the results of the analysis and summarizes the evaluation of Alternative 10 against the study goals and objectives. A cost estimate is not provided since it will vary based on the design and operation of the pilot program. Pilot program service is being recommended in the medium-term followed, if successful by permanent service in the long-term. While it is anticipated the MBTA would assist in developing a pilot program, it is noted that this type of service (primarily peak commuter service only) is not typically provided by the MBTA and permanent service would likely require a private operator. It is also noted that subsequent to the development and analysis of this alternative, and the recommendations developed herein, the MBTA has released a service policy for pilot programs[32] that may alter this recommendation.

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[32] Policy of the Evaluation and Selection of MBTA Service Pilots, MBTA, March 27, 2017.

Table 5-11 Alternative 10 Evaluation and Recommendation

✓	Positive Impact
●	Neutral Impact
✗	Negative Impact
PHO	Public Health Objective

Goals	Objectives	Impact	Comments
Mobility Benefits	Decrease congestion and reduce delays (PHO)	●	1.Potential to reduce crowding on 70/70A and/or other express bus services.
	Improve system reliability	✓[1]	
	Minimize local street impacts	●	
	Maintain emergency vehicle and first responder mobility	●	
Safety Improvements	Identify, eliminate, or mitigate locations and situations that pose hazards (PHO)	●	
	Address current design standard deficiencies (PHO)	●	
Accessibility and Connectivity Benefits	Reduce auto dependency (PHO)	✓	2. Provides an additional transportation option. Potential educational benefits for Perkins School for the Blind. 3. Opportunity to provide connection to Boston Landing Station, however requires schedule coordination.
	Improve existing public transportation services (PHO)	✓[2]	
	Coordinate existing transit services	✓[3]	
	Improve bike and pedestrian connections (PHO)	●	
	Promote active transportation (PHO)	●	
Economic Development Impacts	Support existing and projected economic development	✓[4]	4. Provides access to main economic corridor (Arsenal Street) but service is not on the corridor directly.
	Minimize negative economic effects to tax bases; enhance local and regional economic activity	●	
	Improve non-motorized access and connectivity between business centers and employment centers (PHO)	●	
	Improve access to the regional highway system	●	
	Avoid/minimize/mitigate social equity impacts	●	
	Incorporate healthy community design features (PHO)	●	
Environmental Impacts	Support smart growth, anti-sprawl initiatives (PHO)	●	5. Limited quantifiable greenhouse gas and/or and CO and particulate matter reductions anticipated.
	Avoid/minimize/mitigate impacts to the natural environment	●	
	Minimize greenhouse gas emissions (PHO)	●[5]	
	Reduce CO and particulate matter impacts (PHO)	●[5]	
	Minimize transportation-related noise impacts along the corridor (PHO)	●	
Lasting Benefits	Develop a range of multimodal recommendations that support ongoing changes and have lasting benefits	✓	
Public Support	Encourage consensus through an open and inclusive process	Yes	
Cost	Preliminary Order-of-Magnitude Construction Cost Estimate	TBD[6]	6. Cost will vary depending on type of bus, available fleet, and entity running pilot service.
Recommendation	***Advance Alternative 10 as a study recommendation. Consider potential service between Watertown Square and Boston Landing as a pilot commuter shuttle program. Discard extending service to Packards Corner.***		

Alternative 11: Transit Signal Priority (TSP)

Alternative 11 considers implementation of Transit Signal Priority (TSP) at signalized intersections along the Arsenal Street corridor. Implementation of TSP would enhance service along Route 70/70A between the Watertown Square and Soldiers Field Road gateways.

Analysis of this alternative included a review of existing bus stop locations in relation to signalized intersections, proximity to other bus stops, and the total number of bus stops along the corridor between the gateways. Since the benefit of TSP is affected primarily by bus stop location and frequency, the analysis considered any adjustments that would be required to maximize system effectiveness. The following bus stop adjustments were assumed:

- Relocating the eastbound stop at School Street to the far side of the intersection
- Consolidating the eastbound stop at Arsenal Court
- Consolidating the westbound stop at Talcott Avenue
- Relocating the westbound stop at Arlington Street/Coolidge Avenue to the far side of the intersection

The future conditions VISSIM model, discussed previously in Chapter 3, was used to determine where implementing TSP would be most beneficial. This was done by comparing the projected travel times along the corridor both with and without TSP, and including and excluding the gateway locations on either end of the corridor. The results of the comparison are presented in Table 5-12.

Table 5-12 Expected Changes in Travel Time with TSP

	Morning Peak Hour				Evening Peak Hour			
	Passenger Car		Bus		Passenger Car		Bus	
	percent	travel time	percent	travel time	percent	travel time	percent	travel time
1: Eastbound - excluding gateways	12%	38s	30%	1m 59s	-47%	-5m 25s	-16%	-1m 49s
2: Westbound - excluding gateways	-1%	-4s	-50%	-7m 6s	-39%	-4m 11s	-60%	-12m 10s
3: Eastbound - including gateways	-7%	-1m 43s	8%	2m 18s	11%	3m 4s	1%	20s
4: Westbound - including gateways	10%	1m 22s	-25%	-6m 7s	-17%	-4m 16s	-29%	-9m 19s

Travel time expressed in minutes (m) and seconds (s). Negative travel time denotes time savings.

During the morning peak hour in the westbound direction, and during the evening peak hour in both directions (excluding the gateways in all cases), the reduction in travel time indicates TSP would improve operations for passenger cars and buses along the corridor.

If the gateway intersections are included in the TSP system, time savings become less reliable, particularly for transit serving the eastbound direction. It is noted that bus operations in the westbound direction are projected to be substantially improved if the gateways are included in the system. However, at Watertown Square this improvement would be specific to the Route 70/70A buses and to the detriment of the Route 59 and Route 71 buses which run along other legs of the intersection. Since installation of TSP should not prioritize one bus over another (and such a practice would not be supported by the MBTA), TSP should not be considered in Watertown Square. A similar condition exists at the Arsenal Street/Soldiers Field Road/Birmingham Parkway intersection, where the Route 86 bus operates on Birmingham Parkway and Western Avenue. However, given the operational differences in that traffic signal timing/phasing, which include only one traffic signal affecting bus operations and use of an exclusive right-turn lane along the route, it may be advantageous in the future to include the location in the TSP system, particularly if an adjacent system is considered for Western Avenue.

Based on the analysis above, performance of TSP at the following intersections showed measurable benefits:

- Arsenal Street at North Beacon Street and Taylor Street
- Arsenal Street at Hanover Driveway
- Arsenal Street at Beechwood Avenue
- Arsenal Street at School Street
- Arsenal Street at Talcott Avenue
- Arsenal Street at Arsenal Court
- Arsenal Street at Arsenal Mall Driveway
- Arsenal Street at Watertown Mall

Table 5-13 considers the results of the analysis discussed above, summarizes the complete evaluation of Alternative 11 against the study goals and objectives, and provides a preliminary order-of-magnitude construction cost estimate. Transit Signal Priority is recommended for implementation in the short term, utilizing a system that would work with transponders currently installed in the bus fleet. New detector loops dedicated to TSP at the locations identified above are required to facilitate implementation. Traffic signal cabinet assembly upgrades would also be required. However, the assembly upgrades are also required for implementation of Alternative 17 (see below) and as such, this cost is not included in this alternative.

Table 5-13 Alternative 11 Evaluation and Recommendation

✓	Positive Impact
●	Neutral Impact
✗	Negative Impact
PHO	Public Health Objective

Goals	**Objectives**	**Impact**	**Comments**
Mobility Benefits	Decrease congestion and reduce delays (PHO)	✓[1]	1. Benefits limited to locations along Arsenal Street where TSP is implemented. 2 Where benefits are noted along Arsenal Street, side streets may experience increased delay.
	Improve system reliability	✓	
	Minimize local street impacts	✗[2]	
	Maintain emergency vehicle and first responder mobility	●	
Safety Improvements	Identify, eliminate, or mitigate locations and situations that pose hazards (PHO)	●	
	Address current design standard deficiencies (PHO)	●	
Accessibility and Connectivity Benefits	Reduce auto dependency (PHO)	●[1]	1. Over time, auto dependency can be reduced as technology advances and bus times may be reduced further.
	Improve existing public transportation services (PHO)	✓	
	Coordinate existing transit services	●	
	Improve bike and pedestrian connections (PHO)	●	
	Promote active transportation (PHO)	●	
Economic Development Impacts	Support existing and projected economic development	●	
	Minimize negative economic effects to tax bases; enhance local and regional economic activity	✓	
	Improve non-motorized access and connectivity between business centers and employment centers (PHO)	●	
	Improve access to the regional highway system	●	
	Avoid/minimize/mitigate social equity impacts	●	
	Incorporate healthy community design features (PHO)	●	
Environmental Impacts	Support smart growth, anti-sprawl initiatives (PHO)	●	
	Avoid/minimize/mitigate impacts to the natural environment	●	
	Minimize greenhouse gas emissions (PHO)	✓	
	Reduce CO and particulate matter impacts (PHO)	✓	
	Minimize transportation-related noise impacts along the corridor (PHO)	●	
Lasting Benefits	Develop a range of multimodal recommendations that support ongoing changes and have lasting benefits	●	
Public Support	Encourage consensus through an open and inclusive process	Yes	
Cost	Preliminary Order-of-Magnitude Construction Cost Estimate	$250,000	Does not include cost for upgrade of traffic signal cabinet assembly (see Alternative 17).
Recommendation	***Install TSP along the corridor east of Watertown Square***		

Alternative 13: Transit Stop Turnouts/Curb Extensions

The evaluation of transit stop turnouts/curb extensions include both a spatial and operational review of bus stops along the corridor. The following cases were evaluated:

- Can the location (or immediate vicinity) provide a fully ADA compliant sidewalk with a bus stop turnout?
- Can the location (or immediate vicinity) provide a curb extension without impacting existing or potential future on-street bicycle accommodations?
- How does the potential for transit stop turnout/curb extension affect bus operations?

As discussed in previous sections, while sidewalks exist along both sides of the entire corridor, many locations either only minimally meet current ADA guidelines or have utility pole and/or tree pit obstructions. There are limited opportunities to widen the sidewalk without impacts to private property and as such it was deemed infeasible to provide transit stop turnouts. In consultation with the MBTA, it was also determined that use of turnouts during peak hours might be counterproductive due to difficulties re-entering the travel lane.

The MBTA's preference along the route would be for curb extensions. Curb extensions allow the sidewalk to extend beyond the curb at bus stop locations to facilitate loading and unloading passengers without the bus exiting the travel lane. Due to right-of-way constraints, the provision of curb extensions would require eliminating dedicated bicycle lanes near bus stops and the creation of mixing zones where the bicyclist is required to merge into and out of traffic along the route. Based on the traffic volume along the roadway, curb extensions would also impact through travel of vehicles, potentially increasing vehicle idle time. Since the provision of dedicated bicycle lanes are an important component to active transportation along the corridor, and given the number of bus stops and the frequency with which bicycle lanes would have to transition, curb extensions are not recommended.

Table 5-14 considers the results of the analysis discussed above and summarizes the complete evaluation of Alternative 13 against the study goals and objectives. Alternative 13 is removed from further consideration due to an inability to provide a means to adequately accommodate both transit operations and bicycling without impacting private property and the related difficulty with bus operations along the corridor. As the corridor continues to redevelop, opportunities to incorporate these features without impacts to the bicycle and pedestrian network should be considered.

Table 5-14 Alternative 13 Evaluation and Recommendation

✓ ● ✗ *PHO*	Positive Impact Neutral Impact Negative Impact Public Health Objective	**Curb Extension**	**Turn out**	
Goals	**Objectives**	**Impact**	**Impact**	**Comments**
Mobility Benefits	Decrease congestion and reduce delays (PHO)	✗	✓	
	Improve system reliability	✓	✗	
	Minimize local street impacts	✗	✓	
	Maintain emergency vehicle and first responder mobility	✗	✓	
Safety Improvements	Identify, eliminate, or mitigate locations and situations that pose hazards*	●		
	Address current design standard deficiencies (PHO)	●		
Accessibility and Connectivity Benefits	Reduce auto dependency (PHO)	●	●	1. Impacts are specific to the development of this alternative and not the use of curb extensions where adequate right-of-way is provided.
	Improve existing public transportation services (PHO)	●	●	
	Coordinate existing transit services	●	●	
	Improve bike and pedestrian connections (PHO)	✗[1]	●	
	Promote active transportation (PHO)	✗[1]	●	
Economic Development Impacts	Support existing and projected economic development	●		
	Minimize negative economic effects to tax bases; enhance local and regional economic activity	●		
	Improve non-motorized access and connectivity between business centers and employment centers (PHO)	●		
	Improve access to the regional highway system	●		
	Avoid/minimize/mitigate social equity impacts	●		
	Incorporate healthy community design features (PHO)	●		
Environmental Impacts	Support smart growth, anti-sprawl initiatives (PHO)	●		
	Avoid/minimize/mitigate impacts to the natural environment	●		
	Minimize greenhouse gas emissions (PHO)	●		
	Reduce CO and particulate matter impacts (PHO)	●		
	Minimize transportation-related noise impacts along the corridor (PHO)	●		
Lasting Benefits	Develop a range of multimodal recommendations that support ongoing changes and have lasting benefits	●		
Public Support	Encourage consensus through an open and inclusive process	N/A		
Cost	Preliminary Order-of-Magnitude Construction Cost Estimate	N/A		
Recommendation	***Discard Alternative 13 from consideration due to difficulty with MBTA bus operations and impacts to non-motorized transportation opportunities.***			

Alternative 14: Transit Shelters

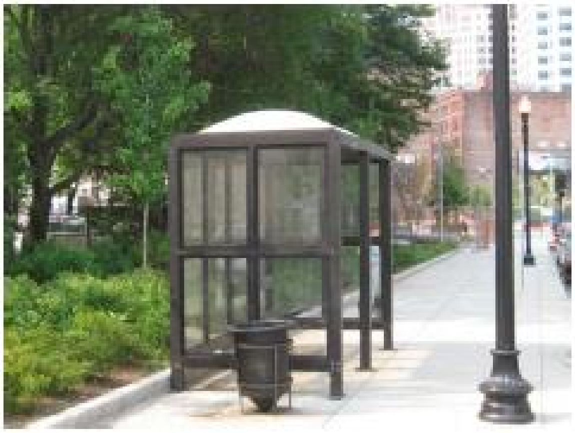
As discussed in Chapter 4, the ability to provide bus shelters was considered for eight locations that meet the MBTA's guidelines for eligibility. Each of the locations was reviewed to determine whether a bus shelter could be installed within the existing right-of-way and in such a way that an accessible path could be provided around the shelter.

The review found that none of the eight eligible locations could accommodate bus shelters within the available right-of-way. However, three locations could accommodate bus shelters with minor impacts to adjacent properties, primarily to grass buffers along the property line. These locations are:

- Opposite Louise Street (westbound)
- Talcott Avenue/Arsenal Court (eastbound)
- Elm Street (westbound)

It is noted that a fourth location, the bus stop opposite School Street, could accommodate a shelter if relocated as proposed in Alternative 11 above. The relocated bus stop would likely have moderate property impacts and require the adjacent property owner to adjust the existing fence line.

Figure 5-10 presents a standard MBTA bus shelter. The MBTA's Bus Stop Planning and Design Guidelines (October 2013) provides additional shelter examples, including narrow shelters (which should be considered for the locations identified above) and different style shelters that can be considered if being funded by the municipality.



Source: MBTA Draft Bus Stop Planning and Design Guidelines (October 2013)

Figure 5-10 Standard MBTA Bus Shelter

Table 5-15 considers the results of the analysis discussed above, summarizes the complete evaluation of Alternative 14 against the study goals and objectives, and provides a preliminary order-of-magnitude construction cost estimate.

Table 5-15 Alternative 14 Evaluation and Recommendation

✓ ● ✗ *PHO*	Positive Impact Neutral Impact Negative Impact Public Health Objective

Goals	Objectives	Impact	Comments
Mobility Benefits	Decrease congestion and reduce delays (PHO)	●	
	Improve system reliability	●	
	Minimize local street impacts	●	
	Maintain emergency vehicle and first responder mobility	●	
Safety Improvements	Identify, eliminate, or mitigate locations and situations that pose hazards (PHO)	●	
	Address current design standard deficiencies (PHO)	●	
Accessibility and Connectivity Benefits	Reduce auto dependency (PHO)	●	
	Improve existing public transportation services (PHO)	✓	
	Coordinate existing transit services	●	
	Improve bike and pedestrian connections (PHO)	●	
	Promote active transportation (PHO)	●	
Economic Development Impacts	Support existing and projected economic development	●	1. Promotes the use of transit and increase public health contributors along Arsenal Street.
	Minimize negative economic effects to tax bases; enhance local and regional economic activity	●	
	Improve non-motorized access and connectivity between business centers and employment centers (PHO)	✓	
	Improve access to the regional highway system	●	
	Avoid/minimize/mitigate social equity impacts	✓	
	Incorporate healthy community design features (PHO)	✓[1]	
Environmental Impacts	Support smart growth, anti-sprawl initiatives (PHO)	●	
	Avoid/minimize/mitigate impacts to the natural environment	●	
	Minimize greenhouse gas emissions (PHO)	●	
	Reduce CO and particulate matter impacts (PHO)	●	
	Minimize transportation-related noise impacts along the corridor (PHO)	●	
Lasting Benefits	Develop a range of multimodal recommendations that support ongoing changes and have lasting benefits	●	
Public Support	Encourage consensus through an open and inclusive process	Yes	
Cost	Preliminary Order-of-Magnitude Construction Cost Estimate	$40,000 per shelter	Does not include property easements, or modifications to sidewalk or utilities.
Recommendation	***Install bus shelters in the above referenced locations.***		

Alternative 15: Existing Transit Service Improvements

Alternative 15 considers improvements to the MBTA's existing Route 70 and 70A services, including potential routing, service frequency, and schedule adjustments. Service frequency and schedule adjustments that are possible given the MBTA's existing bus fleet, resources, and systemwide priorities could improve bus service provided on the Arsenal Street Corridor as well as along the entire Routes 70/70A in the short term. In the medium-term and beyond, expanding the bus fleet could support further adjustments to routing, schedules, and increased service frequency.

The Alternative 15 evaluation conducted as part of this study was specifically focused on addressing concerns on the Arsenal Street Corridor; therefore, it is important to note that any specific recommendations and associated capital and operating costs will need to be further analyzed and refined within the context of the larger MBTA system as part of the MBTA's systemwide service planning processes.

Routing Adjustments

The analysis of routing adjustments considered the following:

- potential termini adjustments for some or all Route 70/70A trips,
- splitting up the Route 70/70A into distinct and shorter routes,
- adding limited-stop express service or consolidating stops on all trips, and
- combining segments of the Route 70A with other existing MBTA bus routes.

Termini Adjustments

Operational reliability on the Routes 70 and 70A is challenged in part by the long lengths of these existing routes. Shortening the length of the routes by adjusting the termini for some or all trips would support improved operational reliability for bus services along the Arsenal Street Corridor.

The evaluation of potential termini adjustments considered the ridership distribution along the existing Routes 70 and 70A to assess opportunities to shorten the route length without reducing service to a high proportion of route ridership. MBTA ridership data from October 2015 were used to identify the stops that have the greatest number of passenger boardings and alightings and evaluate how many passengers would be negatively affected by changing the route termini.

To examine potential termini adjustments to Routes 70 and 70A, it is essential to understand which locations drive ridership on the routes. Table 5-16 examines the total number of boardings and alightings at the 10 busiest locations (grouping inbound and outbound stops). In both the inbound and outbound directions, the

Central Square stops have the highest combined boardings and alightings by a large margin, in every time period. Therefore, all trips should continue to serve Central Square in all time periods.

Table 5-16 demonstrates that the Watertown/Arsenal Mall, Watertown Square, and Waltham Center locations (highlighted in gray) are key ridership drivers. The Watertown/Arsenal Mall stop has limited potential as a terminus because it would divide the Arsenal Street Corridor into multiple routes, and create a two-seat ride to Central Square from the high-ridership Waltham Center and Watertown Square locations. As such, Watertown/Arsenal Mall was dismissed as a potential terminus location, and the potential to adjust the route terminus to either Watertown Square and/or Waltham Center was further assessed.

Table 5-16 Total Number of Daily Boardings and Alightings by Location

Inbound Stop Name	Outbound Stop Name	Total Daily Boardings & Alightings
Massachusetts Ave. @ Pearl St.	Green St. @ Pearl St.	2,544
Green St. @ Magazine St.	Green St. @ Magazine St.	1,402
Carter St. @ Waltham Comm. Rail	Carter St. @ Waltham Comm. Rail S	1,182
Main St. @ Cross St.	Main St. @ Merchants Row	1,080
500 Arsenal St. – Watertown + Arsenal Mall	Arsenal St. @ Watertown + Arsenal Mall	721
Franklin St. @ Sidney St.	Franklin St. @ Sidney St.	637
Western Ave. @ Everett St.	Western Ave. @ Everett St.	378
Arsenal St. Opp. Arlington St.	Arsenal St. @ Arlington St.	306
River St. Opp. Blackstone St.	Western Ave. @ Putnam Ave.	305
Arsenal St. Opp. Elm St.	Arsenal St. @ Elm St.	291

Source: MBTA Loading Data for October 2015 (provided by MBTA).

As demonstrated in Table 5-17, the number of inbound boardings occurring before Watertown Square (Main Street @ Cross Street) ranges from approximately 47-66 percent of total trip boardings in any given period (aggregated across all trips within each period), and is greater than 50 percent in all periods other than the Evening. Similarly, as demonstrated in Table 5-18, the number of outbound alightings occurring after Watertown Square (Main Street @ Merchants Row) ranges from 54-71 percent of total trip alightings in any given period. Adjusting the terminus to Watertown Square would therefore reduce service to a high proportion of passengers in any period and in both directions. The individual trip-level data show a similar pattern as the aggregated period-level data, although a wider range, with no fewer than 25 percent of inbound boardings before Watertown Square and no fewer than 33 percent of outbound alightings after Watertown Square on any given trip.

The analysis findings show a lesser, but still substantial impact when considering Waltham Center (Carter Street @ Waltham Commuter Rail / Moody Street @ Main Street) as a terminus. As demonstrated in Tables 5-17 and 5-18, the number of inbound boardings occurring before Waltham Center ranges from 19-25 percent of total trip boardings in any given period (aggregated across all trips within each period), and the number of outbound alightings occurring after Waltham Center ranges from 18-29 percent of total trip alightings in any given period. Adjusting the terminus to Waltham Center would therefore also reduce service to a high proportion of passengers in any period and in both directions. The individual trip-level data show a similar pattern as the aggregated period-level data, although a wider range, with no fewer than 10 percent of inbound boardings before Waltham Center and no fewer than 10 percent of outbound alightings after Waltham Center on any given trip. In summary, adjusting termini on existing trips without providing additional service to the remainder of the route would result in reduced service to a substantial percentage of riders.

Table 5-17 Percentage of Inbound Boardings by Segment and Period

	Period							
Segment	Night / Sunrise	Early AM	AM Peak	Midday Base	Midday school	PM Peak	Evening	Late Evening
70/70A Before Waltham Center	22%	19%	21%	25%	22%	24%	22%	21%
70/70A Before Watertown Square	66%	65%	65%	61%	55%	53%	47%	55%

Source: MBTA Loading Data for October 2015 (provided by MBTA).

Table 5-18 Percentage of Outbound Alightings by Segment and Period

	Period							
Segment	Night / Sunrise	Early AM	AM Peak	Midday Base	Midday school	PM Peak	Evening	Late Evening
70/70A After Waltham Center	28%	29%	27%	23%	22%	18%	25%	23%
70/70A After Watertown Square	68%	63%	54%	55%	62%	59%	71%	70%

Source: MBTA Loading Data for October 2015 (provided by MBTA).

Route Splitting

As an alternative to termini adjustment, splitting the Routes 70 and 70A into distinct and shorter routes could allow for improved operational reliability without reducing the service provided on any given segment. Based on the termini analysis described above, Watertown Square and Waltham Center were identified as logical places to split the Routes 70 and 70A. Splitting routes at Waltham Center provides an additional benefit as it already serves as the location where Routes 70 and 70A diverge, and because fewer passengers would be affected by such a change.

Splitting routes at Waltham Center would establish three separate routes, illustrated in Figure 5-11: University Park – Cedarwood/Market Place Drive (the existing Route 70, which would continue to serve all existing Route 70 passengers), Waltham Center – North Waltham (the "Loop Circulator" portion of the existing Route 70A, which would replace Route 70A service in this area at similar or greater frequencies), and University Park – Waltham Center (the "Trunk Route" shared between the existing Routes 70 and 70A, which would replace Route 70A service in this area at similar or greater frequencies and supplement the existing Route 70 service through this corridor). This split would improve reliability and on-time performance for all passengers due to the decreased length and number of stops on each route. The split routes would also allow for more targeted service increases to meet demand. For example, providing one additional bus to serve the Trunk Route could be more impactful in reducing passenger crowding than providing one additional bus to serve the entire existing Route 70 or Route 70A. However, the split routes would add a transfer for Route 70A passengers traveling from one side of Waltham Center to the other.

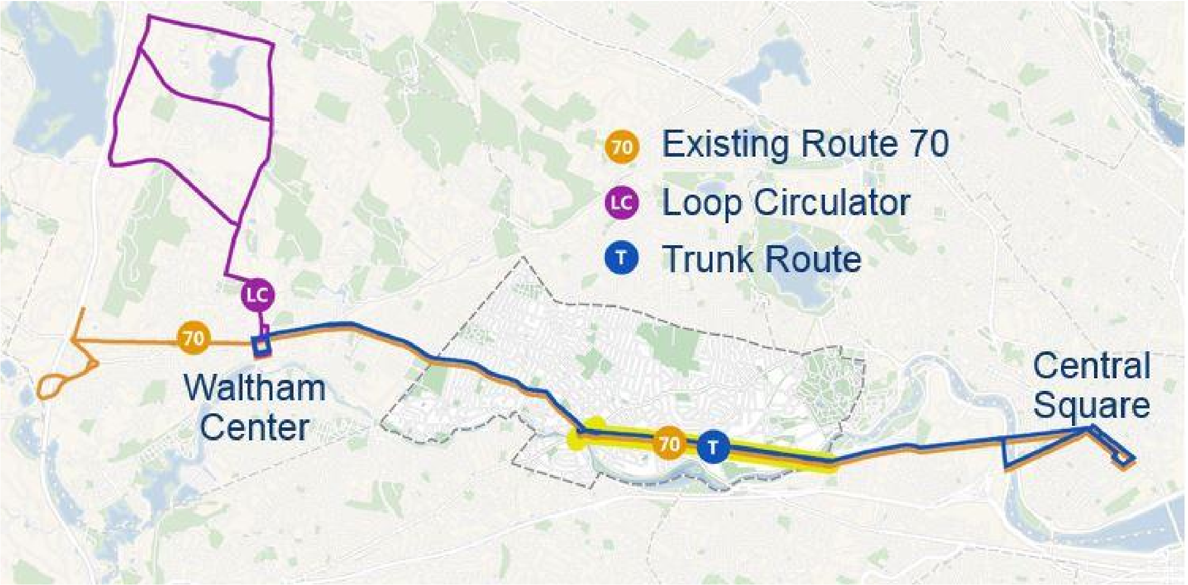


Figure 5-11 **Potential Split Routes**

Transfer Analysis

A transfer analysis was conducted to quantify the percentage of riders on the proposed Loop Circulator who would be impacted with an additional transfer. Transfer impacts resulting from the proposed route splitting were analyzed based on inferred origin-destination data provided by the MBTA.[33] The data indicate that approximately 71 percent of passengers who board on the Route 70A loop would require an additional transfer with split routes. Waltham Center would become one of the largest bus-to-bus transfer locations on the MBTA system. Approximately 38 percent of passengers boarding on the Route 70A loop travel to Central Square. These passengers could benefit from a coordinated transfer to an express route at Waltham Center, or to a consolidated stop service to Central Square, as discussed in the following section of this report. In addition, alternative service improvements along the Loop Circulator, such as increased span of service, should be considered to improve service for passengers burdened by an additional transfer.

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[33] Inferred origin-destination data for October 6, 2015 provided by the MBTA.

The evaluation results demonstrate that the route splitting would add a transfer for the majority of riders on the Loop Circulator. However, the benefits of increased reliability and the potential to alleviate passenger crowding through targeted service increases merits the further consideration of route splitting, along with coordinated transfers and other Loop Circulator service improvements.

Adding Limited-Stop Express Service or Consolidating Stops For All Service

The evaluation of limited-stop express bus service considered Trunk Route (Waltham Center to Central Square) limited-stop express service as an addition to existing local service, as opposed to replacing some existing local trips with limited-stop express trips. The evaluation of additional (as opposed to replacement) express service was performed in cooperation with feedback received from public stakeholders at the October 4, 2016 Arsenal Street Corridor Study public meeting. The alternative of implementing consolidated stop service for all trips was identified through the Study Team's coordination with the MBTA. Consolidated stop service would capture many of the benefits of a limited-stop express service by reducing the delay associated with stopping throughout a trip. These benefits would apply to a lesser extent on each trip (due to a lower reduction in stops) but would apply across *all* trips using consolidated stop service. In addition, consolidated stop service would promote consistency across the schedule to improve passenger usability. The following paragraphs describe the express service evaluation, with the findings and methodology largely applicable to future study and implementation of a consolidated stop service if preferred.

The express route evaluation first identified stop locations between Cambridge and Waltham Center (the trunk of the existing Routes 70 and 70A) with high potential for express service based on an analysis of passenger movements (boardings and alightings) and stop distances. Candidate express stops were identified based on the simultaneous goals of serving high-ridership locations along the Arsenal Street Corridor and along the route, providing consistency for riders with regard to inbound and outbound locations served, and providing adequate stop spacing to maximize potential travel time benefits. Figure 5-12 illustrates potential express stops for consideration based on this preliminary analysis. Tables 5-19 and 5-20 illustrate the percentage of passenger boardings and alightings along the trunk (Waltham Center to Central Square) served by the potential express stops identified in Figure 5-12, by period and direction, under existing conditions. As planning progresses, consideration should also be given to express service at special generators (such as schools) as well as additional stop locations between Waltham Center and Watertown Square.

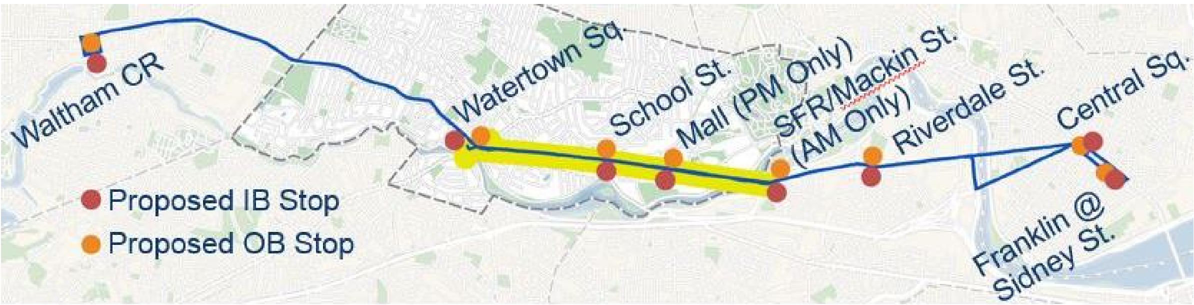

Figure 5-12 Route 70/70A Potential Express Stops

Table 5-19 Percentage of Trunk Boardings &Alightings at Potential Inbound Express Stops

Inbound Stop Name	AM Peak	PM Peak
Carter St. @ Waltham Comm. Rail	7.6%	8.8%
Main St. @ Cross St.	8.9%	7.9%
Arsenal St. Opp. School St.	1.8%	2.9%
500 Arsenal St. – Watertown + Arsenal Mall	-	5.7%
Western Ave. @ Mackin St.	2.8%	-
Western Ave. @ Everett St.	2.9%	3.4%
Mass Ave. @ Pearl St.	28.6%	30.5%
Franklin St. @ Sidney St.	6.5%	3.3%
Total	59.1%	62.5%

Source: MBTA Loading Data for October 2015 (provided by MBTA).

Table 5-20 Percentage of Trunk Boardings & Alightings at Potential Outbound Express Stops

Outbound Stop Name	AM Peak	PM Peak
Franklin St. @ Sidney St.	3.0%	6.0%
Green St. @ Magazine St.	22.1%	18.7%
Western Ave. @ N. Harvard St.	3.5%	2.5%
Western Ave. @ Soldiers Field	3.0%	-
Arsenal St. @ Watertown + Arsenal Mall	-	5.2%
Arsenal St. @ School St.	4.0%	1.7%
Main St. @ Merchants Row	7.7%	9.5%
Carter St. Opp. Waltham Commuter Rail	8.2%	8.4%
Total	51.6%	52.1%

Source: MBTA Loading Data for October 2015 (provided by MBTA).

Adding express service would improve transit travel times by reducing the number of stops a bus would make on a trip. Each bus stop has an associated level of delay ("dwell time") due to a number of factors (e.g., vehicle deceleration, boarding lost time, passenger boarding and alighting, traffic signal delay, reentry delay, and acceleration).[34] While the dwell time due to passenger boarding and alighting may be similar in local and express service if the number of passengers boarding and alighting remains similar, the other factors would likely create a directional impact on the total trip dwell time based on the number of stops (i.e., reducing the number of stops would reduce the total delay). Multiple studies have found this to be the case.[35]

The potential express stops illustrated in Figure 5-12 would reduce the number of stops between Central Square and Waltham Center to seven stops in each direction during the AM Peak and PM Peak periods. In comparison, the existing local trunk service has 50 outbound and 44 inbound stops. These stop reductions can be converted to travel time reductions using an assumed 15 seconds of dwell time per stop, based on typical values of acceleration to 25 miles per hour (5.5 seconds), deceleration from 25 miles per hour (4.5 seconds), and reentry delay (0-10 seconds).[36] This would result in travel time savings on the Route 70/70A trunk of up to 10.75 minutes outbound and up to 9.25 minutes inbound. These estimates represent maximum potential time savings, since they assume that local buses currently stop at all 50 outbound and 44 inbound stops. A more conservative time savings estimate considers the average number of stops actually made per trip. Based on door cycle data provided by the MBTA, Route 70/70A buses currently stop to pick up/drop off passengers at up to two-thirds of all stop locations during the peak hours. Therefore, travel time savings on the Route 70/70A trunk would likely reach up to (approximately) seven minutes in the outbound direction and up to six minutes in the inbound direction.[37]

In addition to travel time savings, limited-stop service has been found to be more reliable than previously existing local-only service along a route.[38] Moreover, the express trips would provide additional capacity to reduce crowding and would offer the potential to accommodate projected increases in ridership demand. Although the limited-stop service could result in irregular combined (local-only and limited-stop) headways, it would reduce headway gaps by providing this limited-stop service as additional service.[39]

The addition of express service also has the potential to induce additional ridership demand through improved reliability and lower travel times, which could make the trip more attractive and competitive, and result in a modal shift.

The preliminary evaluation of express service conducted as part of this study found that adding limited-stop express service has potential to improve transit travel times for express bus riders and would provide additional capacity to alleviate crowding on local buses. Other initial evaluations of express service conducted by the Boston Regional Metropolitan Planning Organization[40] found that there may be potential to implement express service on the Route 70/70A, however additional improvements such as provision of dedicated bus lanes, queue jumps, and/or transit signal priority would be needed to make this route favorable for limited-stop service consideration.

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[34] Transportation Research Board, TCRP Report 165, *Transit Capacity and Quality of Service Manual, Third Edition*, 2013, Page 6-3, Exhibit 6-1.

[35] Transportation Research Board, TCRP Report 165, *Transit Capacity and Quality of Service Manual, Third Edition*, 2013, Page 6-55.

[36] Transportation Research Board, TCRP Report 165, *Transit Capacity and Quality of Service Manual, Third Edition*, 2013, Page 6-55.

[37] Trips outside the peak period/peak direction have fewer average door cycles, and therefore would have lower travel time savings.

[38] Nicholas Hart, Boston Regional Metropolitan Planning Organization staff. “Limited-Stop Study, Phase 1: Review of Limited-Stop Bus Service” DRAFT memorandum to the Boston Regional Metropolitan Planning Organization. May 2015.

[39] Providing consistent combined headways at Waltham Center would result in variability along the Arsenal Street Corridor due to the differences in travel time between the local-only and limited-stop routes. Similarly, providing consistent combined headways along the Arsenal Street Corridor would require irregular departures from Waltham Center. However, despite this irregularity, headway gaps would decrease wherever limited-stop service is added to a local-only service operated with consistent headways.

Based on feedback from the MBTA, there are operational challenges associated with implementing limited-stop express service in combination with other local service on a corridor, including bus bunching and passenger confusion regarding stops served. The MBTA identified consolidating stops for all trips as an operationally preferable alternative to the addition of limited-stop express service on the Route 70/70A corridor. As noted above, consolidating stops would also save travel time through stop reduction; lesser transit travel time savings per trip would be achieved as compared to additional express service, but some travel time benefits would be provided on all trips.

It is recommended that both the addition of limited-stop express service and the consolidation of stops for all trips on the Route 70/70A be considered and further analyzed through the MBTA's systemwide service planning process as part of the next steps for this Alternative.

Route Combination

While the above routing adjustments examined changes to the existing route limits of the Route 70/70A, the route combination alternative considered combining segments of Routes 70 and 70A with other transit routes, with the goal of shifting passengers to those other routes and reducing crowding along the Arsenal Street Corridor. This analysis used transfer data to understand where route combinations would benefit Route 70/70A ridership by providing a single-seat ride instead of requiring a transfer. It examined the routes that have the highest transfer volume to or from Route 70/70A, and assessed how route combinations would affect system operations and system infrastructure.

Table 5-21 displays the daily number of transfers between Route 70/70A and other routes. The majority of transferring passengers do so between Route 70/70A and the Red Line, at a rate of nearly eight times the next most common transfer combination. More passengers transfer between Route 70/70A and the Red Line than between Routes 70/70A and all other routes combined. Improving service to reach the Red Line at Central Square could provide a greater impact than what would be possible through other bus route combinations.

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[40] Nicholas Hart, Boston Regional Metropolitan Planning Organization staff. "Limited-Stop Study, Phase 3: Limited-Stop Service Potential of MBTA Bus Routes" DRAFT memorandum to the Boston Regional Metropolitan Planning Organization. May 2015.

Outside of rail transfers, the most common transfers are between Routes 70/70A and Routes 66, 1, and 71. Of these alternatives, route combination with Routes 66 and 1 is unlikely to be beneficial on the system level as these routes have the third and fourth highest existing weekday ridership in the bus system.[41] Significantly adjusting these routes would inconvenience a high number of Route 66 and Route 1 passengers. In addition, these routes have known crowding issues[42] and thus would be unable to relieve the pressure on Routes 70/70A without additional service.

Meanwhile, although Route 71 has the most similar routing to Routes 70/70A, combining it with Routes 70/70A or extending it for a greater overlap with Routes 70/70A would pose two challenges. First, Route 71 currently operates as a trackless trolley using electric propulsion. Extending it would require either the extension of the overhead catenary system or the purchase of a new fleet of diesel or hybrid electric/diesel vehicles. Second, Route 71 currently has its own crowding concerns which would limit its ability to accommodate additional demand diverted from Routes 70/70A.[43]

Table 5-21 Route 70/70A Daily Transfers

Transfer From	Transfer To	Total
Route 70/70A	Red Line – Central Square	889
Route 70/70A	Route 71	115
Route 70/70A	Route 66	110
Route 70/70A	Route 1	98
Route 70/70A	Route 57	73
Route 70/70A	Route 86	69
Route 70/70A	All Other Routes	248
Red Line – Central Square	Route 70/70A	1004
Route 66	Route 70/70A	129
Route 1	Route 70/70A	120
Route 71	Route 70/70A	94
Route 57	Route 70/70A	74
Route 86	Route 70/70A	68
All Other Routes	Route 70/70A	271

Source: MBTA Ridership Data for October 2015 (provided by MBTA).

Other routes crossing or passing near the 70/70A would not be suitable for route combination. These routes are described below:

- Route 57 operates between Kenmore Station and Watertown Yard. Similar to Routes 66 and 1, however, Route 57 is one of the MBTA's ten highest ridership routes, and faces crowding concerns under existing conditions.

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[41] MBTA ridership and Service Statistics, Fourteenth Edition, 2014.

[42] MassDOT and MBTA, "State of the System Report: Bus," December 2015. This study notes that all Key Bus routes fail MBTA standards for crowding.

[43] MassDOT and MBTA, "State of the System Report: Bus," December 2015. This study notes that all Key Bus routes fail MBTA standards for crowding.

- Route 86 follows Western Avenue along the same route as Route 70/70A between North Harvard Street and Market Street. Rerouting the Route 86 to serve the Arsenal Street Corridor would add considerable travel time for existing ridership on this route.
- Route 170 already serves similar destinations as the non-trunk portions of Routes 70 and 70A (north and west of Waltham Center) and provides express service to Dudley Square, running two trips per day in each direction. As this route already serves the 70/70A corridor, no additional route combinations are recommended.
- Route 52 operates between Watertown Yard and Dedham. Route 59 operates between Watertown Square and Needham Junction. Routes 502 and 504 provide express service between Watertown Square and Boston. Routes 505, 553, 554, 556, and 558 provide various express services through Waltham Center. Transfers between these routes and Route 70/70A are low, so combining these routes with Route 70/70A would not provide significant additional benefits to Route 70/70A ridership, and would have minimal effect on the Arsenal Street Corridor.
- Route 64 follows a nearly-parallel path to Central Square as the Route 70/70A, but does so through Brighton, serving Oak Square and Union Square. Rerouting the Route 64 along the Arsenal Street Corridor would add considerable travel time for existing Route 64 ridership between Oak Square and Union Square.

Recommended Routing Adjustments

Table 5-22 summarizes the initial screening of routing adjustments and the improvements recommended to advance for further planning. Of these routing adjustments, route splitting and additional limited-stop express service or consolidated stop service on all trips are recommended as medium-term improvements due to the potential benefits to reliability, travel time, and crowding along the Arsenal Street Corridor and along the larger route. These alternatives complement each other and could be developed together, including coordination of improved Trunk Route service with the Loop Circulator to achieve timed transfers at Waltham Center.

Table 5-22 Initial Screening of Routing Adjustment Alternatives

✓ Positive Impact
● Neutral Impact
✗ Negative Impact

Routing Adjustment Alternative	On-Time Performance	Crowding	Travel Times	Route Service Coverage	Recommended As Improvement?
Terminal adjustment: Watertown Square	✓	✓	●	✗	No
Terminal adjustment: Waltham Center	✓	✓	●	✗	No
Route splitting	✓	✓	●	●	Medium-Term
Additional limited-stop express service	✓	✓	✓	●	Medium-Term
Consolidated stop service for all trips	✓	●	✓	●	Medium-Term
Route combinations	●	✗	●	●	No

Service Frequency and Schedule Adjustments

The analysis of service frequency and schedule adjustments identified improvements that would relieve crowding and provide more consistent bus headways on the Routes 70/70A. Service frequency and schedule adjustments would complement the routing adjustments in the medium-term. Some service frequency and schedule adjustments could also serve as a stand-alone improvement in the short-term, pending existing MBTA fleet capacity (which is particularly constrained in the peak periods), operating budget, and systemwide priorities. The MBTA's process for evaluating and adjusting schedules includes the quarterly bus service planning process. Any potential service frequency and schedule adjustments would need to be coordinated through the MBTA's bus service planning process prior to implementation.

The analysis presented below is based on the vehicle loading analysis detailed in Chapter 3 and illustrated in Figures 3-1 through 3-4, including existing Fall 2015 loading data and 2040 future year loading projections.

Trip Adjustments to Address Crowding Issues

The findings of an analysis of potential service frequency adjustments that would alleviate existing and projected crowding issues on the Route 70/70A are summarized in Table 5-23. The analysis considers the number of individual Route 70/70A trips that typically exceed loading standards within various key time periods, and quantifies the number of additional trips that would be needed to accommodate excess demands on these overloaded trips. While the average loads across all trips during each time period may meet loading standards, this conservative trip-level analysis is intended to more fully capture impacts to the individual passenger experience. In all time periods, schedule adjustments should be considered to provide consistent headways and to redistribute demands onto trips with additional capacity, where available, which may reduce the required service level increase.

It is important to note that identification and implementation of specific schedule adjustments in the short-term will depend on the MBTA's existing budget and fleet capacity and will require a comprehensive and systemwide analysis as part of the MBTA's quarterly bus service planning process. It is anticipated that short-term increases to service, particularly increases during the peak period, would not be possible unless systemwide priorities and resources are reallocated.

Table 5-23 Potential Service Frequency Adjustments

	EXISTING SERVICE			2040 DEMAND		
	# of trips exceeding load standards	# of passengers in excess of load standards	Additional trips needed	# of trips exceeding load standards	# of passengers in excess of load standards	Additional trips needed
Early AM Period						
Inbound	1	11	1	2	27	1
Outbound	0	0	0	0	0	0
AM Peak Period						
Inbound	4	34	1	4	84	2
Outbound	0	0	0	4	46	1
Midday Base Period						
Inbound	0	0	0	2	7	1
Outbound	0	0	0	2	14	1
Midday School Period						
Inbound	0	0	0	2	7	1
Outbound	0	0	0	1	8	1
PM Peak Period						
Inbound	0	0	0	2	18	1
Outbound	0	0	0	4	17	1
Evening Period						
Inbound	0	0	0	2	20	1
Outbound	2	27	1	8	111	3
Late Evening Period						
Inbound	0	0	0	1	5	1
Outbound	1	5	1	3	24	1
Night/Sunrise Period						
Inbound	2	15	1	2	47	2
Outbound	0	0	0	0	0	0

Notes:

Maximum vehicle load capacity of 54 passengers during Early AM, AM Peak, Midday School, and PM Peak periods.

Maximum vehicle load capacity of 39 passengers during Midday Base, Evening, Late Evening, and Night/Sunrise periods.

Other Considerations

There are several special event demands along the corridor. For example, the Mosesian Center for the Arts often has weekday events from 8:00 – 10:00 p.m. At the

October 4, 2016 Arsenal Street Corridor Study public meeting, a resident noted that Mosesian Center for the Arts eventgoers could better use transit for the event if the event service and MBTA service were better coordinated. Improving trip reliability, via the proposed service improvements discussed as part of this alternative, would allow the MBTA to maintain consistency in scheduling and would better allow event organizers to tie special event start and end times to MBTA service and encourage use of public transit to/from events.

Recommended Service Frequency and Schedule Adjustments

Table 5-24 summarizes the impacts of the recommended trip schedule adjustments discussed in the initial screening above. These adjustments would alleviate passenger crowding by adding trips and reducing headway gaps. The reduced crowding is also expected to increase reliability and improve on-time performance by reducing friction for passenger movements for boarding and alighting, thereby reducing dwell time variability.

Table 5-24 Initial Screening of Schedule/Frequency Adjustment Alternatives

✓ **Positive Impact**
● **Neutral Impact**
✗ **Negative Impact**

Trip Schedule Adjustment Alternative	On-Time Performance	Crowding	Travel Times	Route Service Coverage	Recommended As Improvement?
Adjustments for existing demands	✓	✓	●	●	Short-Term
Adjustments for future 2040 demands	✓	✓	●	●	Medium-Term

Summary of Recommended Improvements and Next Steps

The previous sections describe routing, service frequency, and schedule adjustments that would provide service quality improvements to the MBTA's existing Route 70/70A services. The evaluation was specifically focused on addressing concerns on the Arsenal Street Corridor; therefore, any specific recommendations will need to be further analyzed and refined within the context of the larger MBTA system as part of the MBTA's systemwide service planning processes. Based on the preliminary analysis of potential Route 70/70A improvements, the recommended improvements and next steps for the short-term and medium-term are described below.

Short-Term Improvements and Next Steps

In the short-term, the MBTA may consider service frequency and scheduling improvements that can be implemented with existing resources (pending available MBTA fleet capacity, operating budget, and systemwide priorities), aimed at reducing

Route 70/70A overcrowding on specific trips and providing more evenly timed service along the Arsenal Street Corridor. Currently, four peak period and three off-peak period trips exceed load standards in the inbound direction, and three off-peak period trips exceed load standards in the outbound direction. Due to the particular constraints on MBTA fleet capacity during the peak periods, it may be most feasible to implement improvements to alleviate off-peak crowding in the short-term, unless systemwide priorities and resources are reallocated.

Next steps include further analysis and refinement of specific trip shifts and service adjustments as part of the MBTA's quarterly bus service planning process. The specific schedule recommendations that come out of the MBTA's service planning process will consider updated and expanded data sets, vehicle scheduling and interlining, crew scheduling and union rules, systemwide fleet needs and priorities, other operational decisions, and public stakeholder involvement.

Medium-Term Improvements and Next Steps

In the medium-term, the existing Routes 70 and 70A may be split into three routes, consisting of the existing Route 70, the overlapping "Trunk Route" portion of Routes 70 and 70A, and the "Loop Circulator" portion of Route 70A. Consideration should be given to improving service and/or expanding the service span on the "Loop Circulator", as the split routes would create one of the largest bus-to-bus transfer points in the MBTA system at Waltham Center. In addition, further consideration may be given to limited-stop express service on the "Trunk Route" or consolidated stop service for all trips. Finally, this package of medium-term improvements would further benefit from schedule and service frequency adjustments to accommodate future ridership demand. These adjustments may include trip shifts and additional trips, both during the off-peak and peak periods.

Next steps include further analysis and refinement of the package of medium-term improvements as part of the MBTA's longer term bus improvement plan initiative and the MBTA's bus service planning process. The MBTA's bus improvement plan initiative considers overall agency efforts that lead to partnerships, investments, and larger changes to existing bus routes. The timing for the MBTA's current bus improvement plan initiative is under development, but it is expected that the Routes 70/70A would be evaluated as part of this initiative within the next two years.[44] The MBTA's quarterly service planning process focuses on service changes made by the serving planning and scheduling teams, and will consider updated and expanded data sets, vehicle scheduling and interlining, crew scheduling and union rules, systemwide fleet needs and priorities, other operational decisions, and public stakeholder involvement.

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[44] MBTA. *Service Plan Implementation Bus Network* draft presentation to the MBTA Fiscal Management and Control Board. March 27, 2017.

Order of Magnitude Cost Estimation

Operating and capital costs for the package of Alternative 15 recommendations will depend on the final service schedule and operational decisions made through the MBTA's service planning process. Operating costs will depend on the allocation of resources across all system routes based on systemwide priorities. Capital costs associated with increased service levels on the Arsenal Street Corridor could include costs for additional bus procurement, which would likely be part of a larger MBTA systemwide vehicle procurement. The MBTA's current bus support facilities are at or near capacity, and any expansion of the vehicle fleet would also need to consider the costs associated with the expansion of bus storage and maintenance facility capacity. Due to these considerations, and the systemwide nature of the costs required to support and operate MBTA bus service, the Alternative 15 costs were developed for planning purposes only to compare alternatives within the context of this study. Costs identified herein are for planning purposes only and are not to be used for budgeting.

Preliminary order of magnitude (OOM) operating cost estimates for the Alternative 15 improvement packages were based on existing MBTA operating expenses and estimated increases in annual vehicle miles and vehicle hours required to implement the proposed recommendation packages. The OOM, planning-level incremental operating costs for Alternative 15 are estimated to total approximately $200,000 per year for the short-term recommendations and approximately $800,000 per year for the medium-term recommendations package.

Preliminary OOM, planning-level capital cost estimates for the Alternative 15 medium-term improvements package were based on an estimated fleet size requirement of four additional vehicles to accommodate route splitting and increased service levels to meet 2040 demands. Based on recent MBTA bus procurement data, the estimated capital cost for a new diesel-hybrid bus is approximately $900,000. Based on these assumptions, the OOM, planning-level capital cost for Alternative 15 is estimated to total approximately $3.6 million in the medium-term, excluding capital costs associated with required maintenance facility needs, as well as labor and other operating and maintenance costs. This study assumes that any schedule adjustments ultimately selected for short-term implementation would be accommodated without the need for additional capital investments.

Improvements Evaluation and Recommendation

Table 5-25 considers the results of the analysis discussed above and summarizes the complete evaluation of Alternative 15 against the study goals and objectives.

Table 5-25 Alternative 15 Evaluation and Recommendation

✓	Positive Impact
●	Neutral Impact
✗	Negative Impact
PHO	Public Health Objective

Goals	Objectives	Impact	Comments
Mobility Benefits	Decrease congestion and reduce delays (PHO)	●	1. The medium-term route splitting recommendation is expected to improve transit system reliability along the corridor.
	Improve system reliability	✓[1]	
	Minimize local street impacts	●	
	Maintain emergency vehicle and first responder mobility	●	
Safety Improvements	Identify, eliminate, or mitigate locations and situations that pose hazards (PHO)	●	
	Address current design standard deficiencies (PHO)	●	
Accessibility and Connectivity Benefits	Reduce auto dependency (PHO)	✓	
	Improve existing public transportation services (PHO)	✓	
	Coordinate existing transit services	✓	
	Improve bike and pedestrian connections (PHO)	●	
	Promote active transportation (PHO)	●	
Economic Development Impacts	Support existing and projected economic development	✓	
	Minimize negative economic effects to tax bases; enhance local and regional economic activity	●	
	Improve non-motorized access and connectivity between business centers and employment centers (PHO)	●	
	Improve access to the regional highway system	●	
	Avoid/minimize/mitigate social equity impacts	✓	
	Incorporate healthy community design features (PHO)	●	
Environmental Impacts	Support smart growth, anti-sprawl initiatives (PHO)	✓	2. Transit service improvements with the medium-term recommendations package are expected to increase reliability, reduce crowding, reduce travel times, and increase service frequency, all of which can induce mode shifts from auto to transit and result in emissions benefits.
	Avoid/minimize/mitigate impacts to the natural environment	✓	
	Minimize greenhouse gas emissions (PHO)	✓[2]	
	Reduce CO and particulate matter impacts (PHO)	✓[2]	
	Minimize transportation-related noise impacts along the corridor (PHO)	●	
Lasting Benefits	Develop a range of multimodal recommendations that support ongoing changes and have lasting benefits	✓	
Public Support	Encourage consensus through an open and inclusive process	✓	
Cost	Preliminary Order-of-Magnitude Construction Cost Estimate	$3.6 Million [3]	3. Estimate excludes costs for vehicle storage and maintenance needs.
Recommendation	***Advance analysis and refinement of the short-term and medium-term transit service recommendations as part of the MBTA's systemwide bus improvement plan initiative and the MBTA's quarterly bus service planning process.***		

Alternative 17: Adaptive Signal Control (ASC)

Alternative 17 considers implementing ASC technologies along the Arsenal Street corridor to optimize traffic flow and progression. Analysis of this alterative considers various ASC technologies and evaluates their appropriateness for the corridor. The specific analysis performed is not technical in nature, rather more dependent on whether a system that the town would be able to maintain effectively, using preferred equipment and software, could be developed.

Under future conditions and with the inclusion of planned traffic signals, spacing between traffic signals along Arsenal Street would average 500 to 700 feet. This frequent spacing is a benefit for non-motorized transportation, giving both bicyclists and pedestrians more frequent, controlled locations to cross the street. But closely spaced traffic signals are known to cause driver frustration and increase incidents of yellow and red light running if the system does not function properly. In this case, ASC can be considered a smart traffic signal system, providing traffic signal coordination in "real-time" and dynamically responding to conditions in the field with relatively minor monitoring once the system is running and calibrated to accommodate traffic conditions. The system would allow for the long-term and regular collection of traffic data that the town can utilize to establish measures of effectiveness. These performance measures generated by ASC can be used to automatically evaluate corridor operations.

The project team met with the town to extensively discuss the technical parameters of ASC systems and both hardware and software requirements. The outcome of this meeting indicates that ASC would be a valuable addition to traffic management options for the town. For a fully functional and optimized system, the proposed ASC would focus on the 10 signalized intersections between Watertown Square and Greenough Boulevard North. Apart from newly installed traffic signals (two locations) the traffic signal cabinet assembly should be upgraded at all locations. Regular equipment maintenance is required and it is preferable to have a central control system within the town.

Under the current technical specifications available, it is disadvantageous to include Watertown Square in the ASC system at this time. Watertown Square could be included in an overall central system allowing for real-time monitoring of signal operations at that specific intersection via the processing and gathering of system performance measures. Through the implementation and refinement process, the town could continue to evaluate system performance to determine whether future systems could better incorporate congested intersections.

Table 5-26 considers the results of the analysis discussed above, summarizes the complete evaluation of Alternative 17 against the study goals and objectives, and provides a preliminary order-of-magnitude construction cost estimate.

Table 5-26 Alternative 17 Evaluation and Recommendation

✓ ● ✗ *PHO*	Positive Impact Neutral Impact Negative Impact Public Health Objective		
Goals	**Objectives**	**Impact**	**Comments**
Mobility Benefits	Decrease congestion and reduce delays (PHO)	✓	
	Improve system reliability	✓	
	Minimize local street impacts	●	
	Maintain emergency vehicle and first responder mobility	✓	
Safety Improvements	Identify, eliminate, or mitigate locations and situations that pose hazards (PHO)	●	
	Address current design standard deficiencies (PHO)	●	
Accessibility and Connectivity Benefits	Reduce auto dependency (PHO)	●	1. May anecdotally improve bus travel times, but would not be designed specifically for transit improvements. This credit is noted under system reliability.
	Improve existing public transportation services (PHO)	●[1]	
	Coordinate existing transit services	●	
	Improve bike and pedestrian connections (PHO)	●	
	Promote active transportation (PHO)	●	
Economic Development Impacts	Support existing and projected economic development	✓	
	Minimize negative economic effects to tax bases; enhance local and regional economic activity	●	
	Improve non-motorized access and connectivity between business centers and employment centers (PHO)	✓	
	Improve access to the regional highway system	●	
	Avoid/minimize/mitigate social equity impacts	●	
	Incorporate healthy community design features (PHO)	●	
Environmental Impacts	Support smart growth, anti-sprawl initiatives (PHO)	●	
	Avoid/minimize/mitigate impacts to the natural environment	●	
	Minimize greenhouse gas emissions (PHO)	✓	
	Reduce CO and particulate matter impacts (PHO)	✓	
	Minimize transportation-related noise impacts along the corridor (PHO)	●	
Lasting Benefits	Develop a range of multimodal recommendations that support ongoing changes and have lasting benefits	●	
Public Support	Encourage consensus through an open and inclusive process	Yes	
Cost	Preliminary Order-of-Magnitude Construction Cost Estimate	\$250,000 - \$500,000[2] plus \$350,000[3]	2. Dependent on type of communication and server chosen. 3. Assembly upgrades.
Recommendation	***Install ASC at 10 locations east of Watertown Square***		

Summary

Through the analysis documented in this chapter, Alternative 5 (Road Diet) and Alternative 13 (Transit Stop Turnouts/Curb Extensions) have been eliminated from further consideration. The remaining alternatives have been packaged into short-term (0 to 5 years), medium-term (5 to 10 years), and long-term actions (over 10 years). These actions are determined based on environmental permitting needs, ability to secure funding, and the amount of additional planning required to achieve implementation. Table 5-27 presents a summary of the recommended alternatives and phasing. Chapter 6, Recommendations, will build on the recommendations and phasing and establish an Action Plan with next steps for implementation.

Aesthetics

Through the Working Group process, the aesthetics of the corridor was regularly discussed, as its enhancements improve the public realm and encourage the use of non-motorized active transportation. Where incorporated in the alternatives discussion above, aesthetic improvements to landscaping, streetscaping, and the general character of the roadway serve to further enhance user experience and encourage a more vibrant mix of active, non-motorized transportation along the corridor. While streetscape improvements are considered more closely in the design phase of a project, all alternatives progressed should consider improved amenities through an increased use of landscaping, the addition of street furnishings along the corridor, improved bus stops (see Alternative 14), and the general creation of a "sense of place." For many years, the corridor has been shaped by automobile traffic commuting to, from and through East Watertown. The current redevelopment efforts along the corridor should also serve as a revitalization of the Arsenal Street community and refocus the town's efforts on providing enhanced view sheds and welcoming environments for all roadway users.

Table 5-27 Alternatives Analysis Summary and Study Recommendations

Short-term (0 – 5 years)	Medium-term (5 – 10 years)	Long-term (over 10 years)	Comments
Alternative 1: Bike Lanes East of School Street			If possible, schedule should be coordinated with athenahealth project
Alternative 3: Cross Connectivity between the Greenway and Charles River			
	Alternative 6: Soldiers Field Road Gateway Improvement *Permitting and Design*	**Alternative 6:** Soldiers Field Road Gateway Improvement *Construction*	Permitting and design could be achieved in the medium-term while construction would occur in the long-term.
Alternative 7: Watertown Square Gateway Improvements *Permitting and Design*	**Alternative 7:** Watertown Square Gateway Improvements *Construction*		Continued design development and permitting could be achieved in the short-term, with design and construction occurring in the medium-term. Depending on the funding source, Alternative 7 may extend into the long term.
	Alternative 10: Express Bus along North Beacon Street[1] *Pilot Program*	**Alternative 10:** Express Bus along North Beacon Street *Full Service*	A pilot program could be achieved in the medium-term while full service (and a determination of who would implement such service on a permanent basis) may extend into the long-term.
Alternative 11: Transit Signal Priority			
Alternative 14: Transit Shelters			
Alternative 15: Existing Transit Service Improvements *With Existing Fleet*	**Alternative 15:** Existing Transit Service Improvements *With Expanded Fleet*		Improvements that utilize the existing fleet and are possible given MBTA resources and priorities over the next five years can be achieved in the short-term, while recommendations that may require expanded fleet and further increases to resources are recommended for the medium-term.
Alternative 17: Adaptive Signal Control *Planning/Implementation*	**Alternative 17:** Adaptive Signal Control *Refinement/Upgrades*	**Alternative 17:** Adaptive Signal Control *Maintenance*	Planning and Implementation would occur in the short-term, followed by refinement/upgrades in the medium-term and maintenance over the long-term.

[1] A pilot program may be expedited if advanced by a private party or the TMA

6

Recommendations

Chapters 4 and 5 developed, screened, and analyzed potential transportation and mobility improvements for the Arsenal Street corridor. The alternatives analysis was combined with input from a variety of stakeholders including the Working Group, Town of Watertown, MassDOT, the MBTA, and the public (residents, employers, and workers). These efforts resulted in the identification of recommended improvement projects to be considered for implementation. This chapter presents an "Action Plan" for implementation of the study recommendations.

Overview

The study took a multimodal approach to transportation infrastructure needs and recommends a program of short-term actions (1 to 5 years), medium-term actions (5 to 10 years), and long-term actions (over 10 years). Immediate recommendations (under 1 year) were presented in Chapter 4 and consist of RSAs, traffic signal deficiency/compliance, and curb ramp improvements.

Improved mobility and safety were the primary drivers that guided the development of the recommended Action Plan. This study does not identify specific funding sources for each recommendation because of the many variables and the uncertainty associated with funding sources and schedules for projects. While funding is always a consideration and was factored into the evaluation criteria, funding availability was not a primary driver for the development of the study recommendations.

It is acknowledged that the recommendations presented herein represent a significant investment in potential transportation-related infrastructure. These projects represent an investment in total that currently far exceeds available funding as presently programmed. The advancement of the recommendations developed as part of this study will require prioritization by (and coordination between) the Town of Watertown, MBTA, MassDOT, and other stakeholders to address current fiscal constraints as related to transportation improvements. Besides prioritization, identification of potential funding sources and availability to leverage funding could alter priorities.

Recommended Action Plan

Table 6-1 presents the details of this Action Plan, including construction cost estimates, potential funding sources, the responsible facilitating organizations, the implementation timeframe, and specific next steps. Figure 6-1 presents an overview of the recommended non-transit projects that comprise the Action Plan. Figure 6-2 focuses specifically on transit recommendations.

Each of the projects will need to follow a multi-step process as shown below. Depending on the project, some of the early steps may have already been completed either as part of this study or in other studies.

- Step 1: Problem/Need/Opportunity Identification
- Step 2: Project Planning
- Step 3: Project Initiation
- Step 4: Environmental Review and Permitting /Design/Right-of-way Acquisition
- Step 5: Funding/Programming on the Regional and State Transportation Improvement Programs
- Step 6: Advertise/Bid and Contract Award
- Step 7: Construction

As noted in Table 6-1, some recommendations are not anticipated to require environmental review and permitting. More complex recommendations, such as **Soldiers Field Road Gateway Improvements** and **Watertown Square Gateway Improvements,** will likely require more in-depth design, permitting, and environmental documentation. These initial steps would begin in the immediate- or short-term timeframes. Right-of-way acquisition is anticipated for some of the recommendations, as noted in Table 6-1.

The town’s bicycle network continues to evolve and will become more robust with plans for connections between Arsenal Street and Saltonstall Park and for an extension of the Watertown Greenway to the existing Fresh Pond trail system. The recommendations of this study should be coordinated, with respect to timing and scope, with these and other ongoing initiatives to develop a comprehensive bicycle network. For example, **Bicycle Lanes East of School Street** should be coordinated with the planned bicycle accommodations to the west being advanced by athenahealth. Similarly, **Cross Connectivity between the Greenway and Charles**

River should be coordinated to connect with the Arsenal Street bicycle accommodations and could evolve to interface more directly with the Hanover/Elan Union Market east-west pathway to improve connectivity between the river and the neighborhoods north of Arsenal Street.

As noted in Chapter 4, along with supporting appendix materials, there are several immediate safety and operational improvements that could be implemented along the corridor, as well as accessibility improvements that could be made to existing curb ramps throughout the corridor. These improvements fall solely under the jurisdiction of the town and do not require coordination with other agencies or jurisdictions. Most of these improvements could be completed as part of regular intersection maintenance and should be progressed as quickly as possible. Changes to curb ramps, which in some cases require reconstruction of the entire ramp, should be planned and programmed over the next year.

Funding Sources

Although not an exhaustive list, Table 6-1 provides possible funding sources for each of the alternatives recommended. The funding sources noted were chosen based on the anticipated size, scope, and cost of a particular project. It was assumed the town would consider state and/or federal funding assistance for higher cost projects. In these cases, the town is generally responsible for any permitting and design associated with the improvement and the state provides funding for certain construction elements. Town and private developer funds can come from a variety of sources and were not specifically delineated for the purposes of the Recommended Action Plan. Three state funding sources were identified. It should be noted that Chapter 90 funding (discussed below) may also be used discretionally by the town to cover project design costs.

- **Complete Streets Funding** –The state currently offers up to $400,000 of construction finding per year to eligible communities to implement Complete Streets infrastructure elements. These can include enhancements or dedicated accommodations for bicycle, pedestrian, and transit use, upgrading existing infrastructure to meet current ADA standards, and constructing “missing links” in roadway infrastructure that would improve access for non-automobile users. To be eligible for funding, the town must have a MassDOT approved Complete Streets policy and prioritization plan. Additional information on this funding source can be found at http://mass.gov/massdot/completestreets.

- **Chapter 90 Funding** - The state currently provides reimbursement funding for projects that create or extend the life of capital facilities under Section 34 of Massachusetts General Law (MGL) Chapter 90. Within all applicable allowances, municipalities have discretion on how the funding can be used. The funding amount allocated is based on the municipality’s accepted road miles, population, and employment. For the fiscal year 2017, Watertown received $742,636 of Chapter 90 funds to cover 72 lane miles. This is on par with allocations from previous years. Additional information on this funding source can be found at http://mass.gov/massdot/chapter90.

- **Transportation Improvement Plan Funding** – Each Metropolitan Planning Organization (MPO) within the state has a rolling, five-year capital funding program. Eligible transportation projects can receive federal and state roadway funding if the project is selected by the MPO. Selection is based on an evaluation and prioritization of all eligible projects and includes municipal and public feedback. Additional information on this funding source can be found at http://ctps.org/tip-dev.

Table 6-1 Recommended Action Plan – Commitment Matrix and Implementation Timeframe

Alternative	Construction Cost [1]	Possible Funding Source(s)	Facilitating Organizations					Implementation Timeframe (Years)											Next Steps		Notes
			MassDOT	MBTA	DCR	Town of Watertown	EEA	Short-Term					Medium-Term					Long-Term	Next Steps	Responsible Party	
								1	2	3	4	5	6	7	8	9	10	10+			
1. Bicycle Lanes east of School Street	$75,000 to $2,100,000[2]	• State Complete Streets • State Chapter 90 • Private developer			X	X		■	■	■									Advance to final design. Seek funding source(s).	Town	No environmental review/perming anticipated. Preferable to coordinate with athenahealth bike lanes.
3. Cross Connectivity between the Greenway and Charles River	Variable	• Paths being advanced by others • Town funds for shared lane markings			X	X		■	■	■	■	■							Support path development by others. Determine support for Complete Streets elements on neighborhood streets.	Town	No environmental review/perming anticipated. May be required if formal crossings of Charles River Road are developed
6. Soldier's Field Road Gateway Improvements	$1,500,000 to $2,500,000	• Town funds • Private developer • State Transportation Improvement Program	X		X	X	X						Permitting and Design	■	■	■	■	Construction	Advance design. Stakeholder outreach. Research permitting requirements.	Town	ROW acquisition anticipated. Will require additional public and stakeholder outreach.
7. Watertown Square Gateway Improvements	$950,000 to $1,500,000[3]	• Town funds • Private developer • State Transportation Improvement Program	X	X	X	X	X			Permitting and Design	■	■	Construction	■	■				Advance design. Engage DCR. Study Charles River Road cut-through traffic impacts.	Town	ROW acquisition anticipated. Will require additional public and stakeholder outreach.
10. North Beacon Street Express Bus	Variable	• Area stakeholders • MBTA • TMA		X		X							Pilot Program	■	■	■	■	Full Service	Establish pilot program.	Town/MBTA	Potential ROW acquisition for transit stops.
11. Transit Signal Priority	$250,000 + Upgrades[4]	• Town funds • Private Developer		X		X			■	■	■	■							Advance system design. Coordinate bus stop modifications. Identify signal upgrades.	Town/MBTA	ROW acquisition or easements anticipated for relocation of bus stops.
14. Transit Shelters	$30,000/ location	• Town funds • Private Developer • MBTA		X		X		■	■										Determine installation & maintenance responsibility. Initiate easement process.	Town/MBTA	All locations require small easements from property owners (ROW acquisition).
15. Transit Service Improvements to Existing Routes	$3,600,000[5]	• MBTA		X		X		With Existing Fleet	■	■	■	■	With Expanded Fleet	■	■	■	■		Further analyze and refine as part of the MBTA's bus service planning process and bus improvement plan initiative.	MBTA	Alternative 15 cost estimates are intended solely for purposes of comparing alternatives within the context of this study and are not for budgeting purposes. Capital and operating costs will depend on the allocation of MBTA resources across all system routes based on systemwide priorities.
17. Adaptive Signal Control	$250,000 to $500,000[4,6]	• Town funds • Private Developer		X		X				Planning/ Implementation	■	■	Refinement/Upgrades	■	■	■	■	Maintenance	Advance system design. Identify signal upgrades. Further evaluate Watertown Square operations.	Town	

MassDOT - Massachusetts Department of Transportation, MBTA - Massachusetts Bay Transportation Authority, DCR - Department of Conservation and Recreation, EEA - Executive Office of Energy and Environmental Affairs

Information on state funding sources can be found at the following locations: Complete Streets (mass.gov/massdot/completestreets), Chapter 90 (mass.gov/massdot/chapter90), State Transportation Improvement Program (ctps.org/tip-dev)

[1] Construction cost estimates in 2017 dollars. Estimates do not include survey, design fees, right-of-way (ROW) acquisition, permitting, drainage improvements, or utility modifications (if necessary).

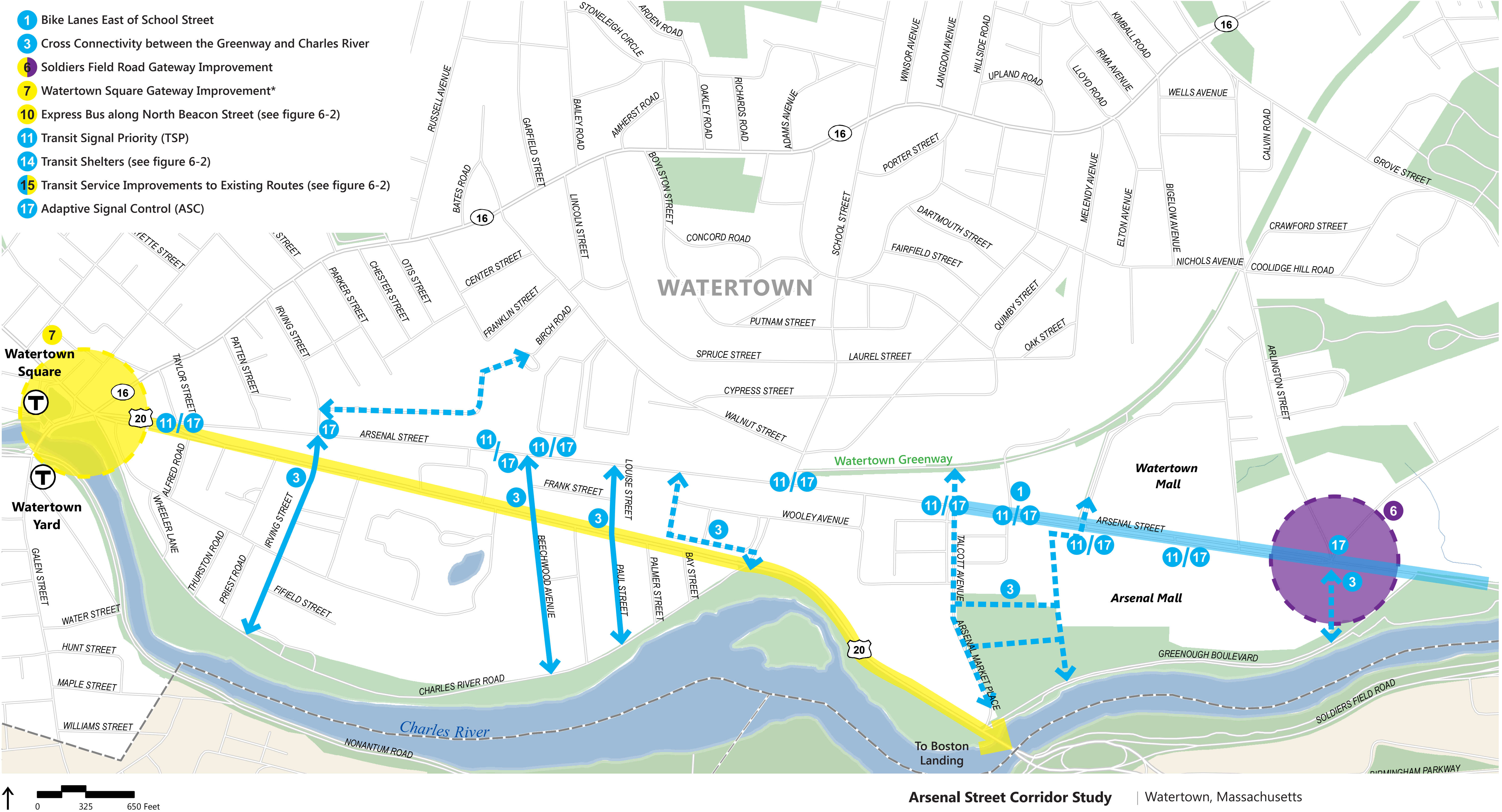
[2] Lower cost estimate includes removal of paint markings and restriping only. Higher cost estimate includes cold plane/overlay in addition to restriping.

[3] Costs may be increased by signal system upgrades/modifications, hardscape/ landscape design, pedestrian lighting, site furnishings.

[4] New traffic signal cabinet assembly may be required at some locations. The cost of a new assembly is approximately $40,000 per location. If the intersection is recommended for both transit signal priority and adaptive signal control, this cost is incurred only once.

[5] Estimate includes capital cost only for additional vehicles anticipated for medium-term recommendations, and excludes capital costs associated with expanded fleet storage and maintenance facilities. Incremental operating costs are estimated at $200,000 and $800,000 per year for short-term and medium-term recommendations, respectively.

[6] Ultimate cost will be dependent on type of communication and server chosen.



1 Bike Lanes East of School Street
3 Cross Connectivity between the Greenway and Charles River
6 Soldiers Field Road Gateway Improvement
7 Watertown Square Gateway Improvement*
10 Express Bus along North Beacon Street (see figure 6-2)
11 Transit Signal Priority (TSP)
14 Transit Shelters (see figure 6-2)
15 Transit Service Improvements to Existing Routes (see figure 6-2)
17 Adaptive Signal Control (ASC)

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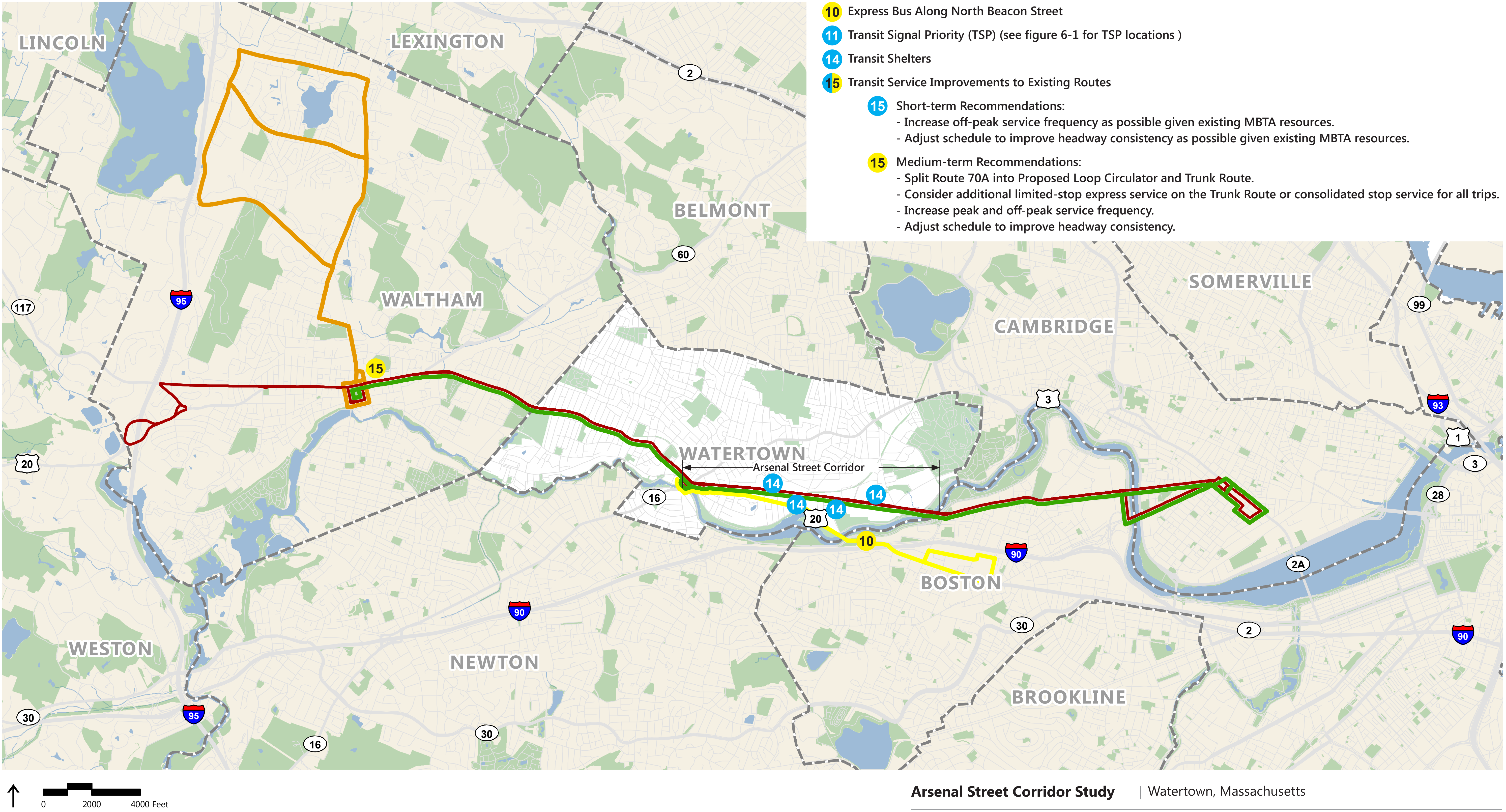
X Short-Term (0-5 years)
X Medium-Term (5-10 years)
X Long-Term (10+ years)
- - - By Others

Note: Funding availability (ie. State Transportation Improvement Program) may impact assumed recommendation time frames.

Study Recommendations

Source: MassGIS



10 Express Bus Along North Beacon Street

11 Transit Signal Priority (TSP) (see figure 6-1 for TSP locations)

14 Transit Shelters

15 Transit Service Improvements to Existing Routes

15 Short-term Recommendations:
- Increase off-peak service frequency as possible given existing MBTA resources.
- Adjust schedule to improve headway consistency as possible given existing MBTA resources.

15 Medium-term Recommendations:
- Split Route 70A into Proposed Loop Circulator and Trunk Route.
- Consider additional limited-stop express service on the Trunk Route or consolidated stop service for all trips.
- Increase peak and off-peak service frequency.
- Adjust schedule to improve headway consistency.

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Transit Recommendations Summary

Source: MassGIS

- X Short-Term (0-5 years)
- X Medium-Term (5-10 years)
- Existing Route 70
- Proposed Loop Circulator
- Proposed Trunk Route

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ARSENAL STREET

CORRIDOR STUDY

Working Group and Public Information Meeting Summaries

September 30, 2015 – Working Group Meeting #1

January 26, 2016 – Working Group Meeting #2

February 24, 2016 – Public Information Meeting #1

June 28, 2016 – Working Group Meeting #3

August 3, 2016 – Working Group Meeting #4

October 4, 2016 – Public Information Meeting #2

January 24, 2017 – Working Group Meeting #5

March 2, 2017 – Working Group Meeting #6

June 22, 2017 – Public Information Meeting #3

ARSENAL STREET
CORRIDOR STUDY

Arsenal Street Corridor Study Working Group Meeting #1: Summary

September 30, 2015, 3:30 PM, Watertown Savings Bank Meeting Room, Watertown Free Public Library, 123 Main Street, Watertown, MA

Purpose

The purpose of the first working group meeting for the Arsenal Street Corridor Transportation Study was to provide an opportunity for the project team to provide an introduction of the study and solicit feedback on the study goals, objectives, and evaluation criteria.

Handouts

Draft Arsenal Street Corridor Study Goals, Objectives, and Evaluation Criteria

Present

Ethan Britland and Michael Clark, Massachusetts Department of Transportation (MassDOT) Office of Transportation Planning (OTP); Laura Castelli and Albert Ng, VHB; Sarah Paritsky and Emily Christin, Regina Villa Associates (RVA); and the following members of the Working Group:

Andrew Bettinelli, Office of Senator Brownsberger
Jonathan Bockian, Watertown Public Transit Task Force (WPTTF)
Pat Connolly, athenahealth
Chief Raymond Dupuis, Watertown Police Department
Christine Dwyer, Perkins School for the Blind
Susan Falkoff, Watertown Town Council
Sam Feigenbaum, Office of Representative Hecht
Lisa Feltner, WPTTF/Concerned Citizens Group
Larry Field, Massachusetts Smart Growth Alliance
Philip Groth, MBTA
John Hawes, Watertown Planning Board
Coriana Hunt Swartz, WPTTF/Flat Earth Theatre
Emily Izzo, Office of Representative Lawn
Raj Kulen, MassDOT District 6
Jaimi Lard, Perkins School for the Blind
Cecilia Lenk, Watertown Town Council
Joe Levendusky, WPTTF
Steve Magoon, Town of Watertown
Raul Mendez, Watertown Police Department
Roberta Miller, The Arsenal Project
Melissa Santucci Rozzi, Watertown Zoning Board of Appeals
Gideon Schreiber, Town of Watertown
Matt Shuman, Town of Watertown

Meeting Summary

MassDOT Project Manager Michael Clark opened the meeting and reviewed the agenda. Mr. Clark described the background and purpose of the study, which will include an evaluation of existing and future multi-modal transportation conditions along Arsenal Street. Impacts of future development expected over the next twenty years will be considered, as the study team proposes multimodal and "complete streets" solutions conducive to bus riders, bicyclists, pedestrians, and motorists.

Mr. Clark reviewed the schedule for the study's six tasks, which will each take place over the next 18 months (approximately). Task 1 involves identifying the study's goals, objectives, and evaluation criteria, as well as formulating a public involvement plan, which will include six Working Group and three public meetings over the course of the study. Task 2 involves data collection for existing conditions along the corridor and an evaluation of issues and opportunities. Alternatives development will dominate the third task, the fourth task will involve alternatives analysis, and Task 5 will involve recommendations. During Task 6, MassDOT will offer a 30-day public comment period on the Final Report.

Mr. Clark introduced the study's consulting team and asked Working Group members to introduce themselves.

Laura Castelli of VHB introduced herself and explained the role of the Working Group within the study. Ms. Castelli said the project team will rely on the Working Group to provide feedback and advice on local issues which will help determine the study's alternatives analysis. Ms. Castelli reviewed the list of Working Group member organizations.

Ms. Castelli then described the Study Area. The study team will collect quantitative data along Arsenal Street from Watertown Square to Birmingham Parkway in Boston. Regional data will be qualitatively analyzed beyond the local study area. There are twenty intersections along the corridor where traffic data (vehicle speeds and volumes) were collected. She pointed out the intersections along Arsenal Street where traffic is most dense.

Question: Are we taking into consideration the intersections of Mt. Auburn Street, School Street, and Walnut Street? Ms. Castelli said the team will qualitatively assess those intersections.

Question: Is it possible to collect additional traffic counts at new locations if, later in the process, they are needed? Ms. Castelli said the study team could collect additional traffic counts to support short-term alternatives, if needed, but not to better inform long-term alternatives. Additional traffic counts required to advance long-term alternatives would be collected as part of the further planning and design of those alternatives.

Question: There are many impacts to bus service on Arsenal Street that happen outside of the corridor. How will those be taken into account? Ms. Castelli said the study team will be assessing the regional impacts qualitatively.

Ms. Castelli moved on to describe the study's goals and objectives and explained that these will be the basis for developing and analyzing the alternatives. Alternatives may include long-term solutions over the next 10 to 20 years that will ultimately undergo a separate permitting and design process, short-term solutions that could be implemented over the course of two to 10 years, and immediate changes that can be implemented in six to 12 months. Ms. Castelli reviewed the evaluation criteria for each of the following goals:

- Improve mobility and traffic flow
- Enhance safety
- Improve access/connectivity for all modes

- Meet transportation goals while supporting economic development and improving quality of life
- Meet transportation goals while minimizing impacts to the environment
- Develop a range of multi-modal recommendations that support ongoing changes and have lasting benefits

Ms. Castelli noted that some of the evaluation criteria for these goals and objectives are related to improving public health, which will be used as another benchmark to help rank alternatives. Ms. Castelli said there are three high-crash locations along the corridor – the study will look at why these clusters are occurring here and if the study can recommend changes to improve safety for all transportation users. Ms. Castelli also noted that the study's alternatives will support ongoing traffic changes and have long-term improvements to traffic flow. The solutions will comply with MAP-21, the federal transportation funding program (or its fiscal year 2016 replacement).

Question: How will the public health considerations be called upon to rank alternatives? Ms. Castelli noted that public health is only one of the ways to prioritize alternatives. The team does not yet know what health data are currently available, so there is no weight designated to the evaluation criteria at this time.

Ms. Castelli emphasized the importance of having an open and inclusive process for the study. There will be many opportunities for public comment throughout the study. The study team will reach out to communities traditionally underserved as well. Ms. Castelli introduced Sarah Paritsky from RVA to discuss the Public Involvement Plan.

Ms. Paritsky explained that the schedule for the six Working Group meetings and three public information meetings is subject to change, but will be aligned with key project milestones. Ms. Paritsky encouraged the members of the Working Group to let the project team know if any additional people/organizations should be included in the Working Group. There is a project website and two email lists: one for the Working Group and one for the public. The study team will notify both email lists of study updates and scheduled meetings. Ms. Paritsky also noted that MassDOT's media team will reach out to local newspapers regarding the study and announce public meetings.

Ms. Castelli explained that the data collection is ongoing and a lot of work has already been done. The existing conditions analysis is underway and the team expects to receive the collected traffic volume data shortly. The team will be collecting environmental resource data in the study area over the next two months. A highway engineering review will look at the accessibility of ramps and sidewalks.

Ms. Castelli reviewed the study's next steps. The existing conditions data evaluation will be the major baseline for the study. The study team will identify issues, opportunities, and constraints before developing alternatives. The next Working Group meeting is scheduled for approximately mid-January 2016.

Question & Answer Session

Ms. Castelli welcomed questions from the Working Group.

Question: Will the study include analysis of land use data? Ms. Castelli is collecting land use data at the parcel scale.

Question: What do you mean by "community effects"? Ms. Castelli is considering socioeconomic data and potential effects to Environmental Justice populations in East Watertown.

Question: Are you planning to incorporate development plans that have already been approved? Ms. Castelli said she will discuss previously approved plans and how they are incorporated into this study at the third Working Group meeting. The study is using the base future year 2035. MassDOT is working closely with CTPS (Central Transportation Planning Staff) who will provide the study area's projected growth rate. The team will also meet with the Town and the study will consider other traffic studies related to proposed developments.

Comment: There are a lot of small businesses along the study area that would be good to reach out to. Ms. Castelli was thankful for the comment and said the team will take that into consideration.

Question: Is the Americans with Disabilities Act (ADA) and snow removal part of this study? Ms. Castelli said the study will not address short-term snow removal concerns. Snow removal will be included in long-term management plans. The study team will take note if any sidewalks are in bad condition during data collection.

Question: What kind of data is being collected for public transit? Mr. Ng of VHB said the project team is collecting data on bus schedules, ridership data, locations of stops, and more. Mr. Groth of the MBTA added that an automatic vehicle locator is used by the MBTA dispatcher to track locations and times of buses. Automated Passenger Counts are generated from infrared technology that counts the number of people boarding and alighting.

Comment from Joe Levendusky, WPTTF: Take into consideration that quantitative data doesn't necessarily lead to a full understanding of the conditions of the public transit. You should also ride the buses and talk to passengers to get a more complete understanding. Ms. Castelli thanked Mr. Levendusky for his comments and said members of the study team will be riding the buses and walking and biking throughout the study area. The study team will also solicit rider feedback at the public meetings.

Comment from Mr. Levendusky: The WPTTF is in the process of publicizing an incident report for public transit in the area based on user information. We can share that with you. Ms. Castelli thanked Mr. Levendusky for his offer.

Question: Will car ownership data be taken? How? Ms. Castelli said the team will use U.S. Census American Community Survey (2014) data for car ownership data and will also consider the state excise tax dataset.

Question: Will this study result in metrics for evaluating the success of the alternatives once they are implemented? Ms. Castelli said the team will try to develop metrics for use in evaluating alternatives, but evaluating long-term success is always challenging.

Mr. Castelli thanked the Working Group for attending and concluded the meeting.

ARSENAL STREET
CORRIDOR STUDY

Arsenal Street Corridor Study Working Group Meeting #2: Summary

January 26, 2016, 9:00 AM, VHB Offices, Center for Education, 101 Walnut Street, Watertown, MA

Purpose

The purpose of the second working group meeting for the Arsenal Street Corridor Study was to provide a summary of the Existing Conditions Evaluation and an overview of the ongoing development of Future No-Build Conditions.

Present

Ethan Britland and Michael Clark, Massachusetts Department of Transportation (MassDOT) Office of Transportation Planning (OTP); Laura Castelli, Elsa Chan, and Niki Hastings, VHB; Emily Christin and Sarah Paritsky, Regina Villa Associates (RVA); and the following members of the Working Group:

Andreas Aeppli, Resident
Jonathan Bockian, Watertown Public Transit Task Force (WPTTF)
Peter Centola, Town of Watertown
Pat Connolly, athenahealth
Christine Dwyer, Perkins School for the Blind
Susan Falkoff, Watertown Town Council
Lisa Feltner, Watertown Town Council
Larry Field, Massachusetts Smart Growth Alliance
Michael Garvin, City of Waltham
Philip Groth, MBTA
John Hawes, Watertown Planning Board
Rep. Jon Hecht, Massachusetts House of Representatives
Jeff Heidelberg, Boylston Properties
Coriana Hunt Swartz, WPTTF/Flat Earth Theatre
Emily Izzo, Office of Representative Lawn
Erin Kinahan, MassDOT District 6
Raj Kulen, MassDOT District 6
Chris Kuschel, MAPC
Jaimi Lard, Perkins School for the Blind
Mark MacLean, DCR
Steve Magoon, Town of Watertown
Vincent Piccirilli, Watertown Town Council
Melissa Santucci Rozzi, Watertown Zoning Board of Appeals
Gideon Schreiber, Town of Watertown
Matt Shuman, Town of Watertown
Bill York, Resident

Meeting Summary

Laura Castelli, VHB Project Manager, opened the meeting and welcomed attendees. She introduced MassDOT Project Manager Michael Clark. Mr. Clark reviewed the agenda, study background and purpose, and study schedule. He noted that the study is on schedule and this is first of two Working Group meetings regarding Future No-Build Conditions and Issues Evaluation. Mr. Clark introduced the study team and led a round of introductions.

Ms. Castelli presented the Existing Conditions Evaluation for transit. She showed a map of the existing bus routes in the study area, and a list of connections to Greater Boston that are provided by these bus routes. She noted that the study team will keep this in mind when developing alternatives.

Ms. Castelli showed a table of service times and frequencies of bus Routes 70 and 70A. Route 70 operates twice as frequently as Route 70A.

Comment: An attendee said there is a rumor that Route 70 has altered its route to accommodate new destinations like Market Basket. Philip Groth, MBTA, said that is true.

Ms. Castelli summarized the condition of bus stops along the corridor, including nine inbound and ten outbound stops. She showed maps of the inbound and outbound stops with insets of photographs of each stop. The sidewalk clearance is generally adequate for the majority of the inbound stops. There are more obstructions at the outbound stops, such as utility poles. At one outbound stop, the project team observed people waiting for the bus in the middle of the bicycle path due to the presence of a construction fence blocking the waiting area.

Ms. Castelli showed a map of the bus stops that have the highest numbers of daily boardings and alightings. The highest ridership stops are Watertown Yard, Watertown Square, Centre Street in Newton, and the Watertown and Arsenal Mall. This data may change as ongoing and proposed developments shape the corridor.

Ms. Castelli reviewed the MBTA's *Service Delivery Policy,* which defines the "acceptable levels of crowding by time period and transportation mode" for all of its services. She explained that Routes 70 and 70A bus service on Arsenal Street meet the *Service Delivery Policy's* standards the majority of the time. A table of weekday maximum average passenger loads for Routes 70 and 70A shows that there are a few time periods in which not every passenger can have a seat.

Ms. Castelli presented a graphic of the average vehicle loads on MBTA buses along Arsenal Street by segment for inbound and outbound service. For any load beyond 39 passengers, some passengers must stand. The average vehicle loads never exceed 54 (the MBTA service limit standard) during peak hours along the corridor. Ms. Castelli also presented a table of weekday average trip on-time performance by time period of Routes 70 and 70A along the corridor.

Comment: Mr. Groth explained that as of now, buses that leave early, which is common for buses that operate in a loop, are considered "not on time." He said the *Service Delivery Policy* may change to allow buses to leave up to one minute early.

Question: Rep. Jon Hecht asked how the Route 70 and Route 70A service day averages compare to service overall in the MBTA. Mr. Groth and Ms. Castelli said that 70-75% average on-time performance is the goal, so Routes 70 and 70A are average compared to routes in surrounding communities.

Comment: Susan Falkoff, Watertown Town Council, said that buses leaving early are worse than being late. Mr. Groth said that the MBTA would not implement a change to the *Service Delivery Policy* regarding the allowance of early departures without discussing changes with riders first.

Comment: Jonathan Bockian, WPTTF, said that the averages do not show wait times. He said that the WPTTF is collecting better data that would be useful. Ms. Castelli noted that the project team is not just looking at quantitative data, but is also obtaining anecdotal data on the corridor.

Comment: Mr. Groth offered to share granular data with the Working Group.

Question: Rep. Hecht asked how the project team is considering impacts of new transit options in their projections. Ms. Castelli said the project team is looking at Central Transportation Planning Staff's (CTPS's) Transit Forecast in 2040, regional traffic studies and developer information, and demographic data. The team will make assumptions based on current transit use and population data to predict any increase in transit use.

Question: Larry Field, MA Smart Growth Alliance, asked if the project team is just going to use aggregated data. Ms. Castelli explained that the team is taking a holistic look at the corridor and will compare their observations with the sources of data mentioned.

Ms. Castelli presented the Existing Conditions Evaluation for traffic and safety. She showed a map of the 20 intersections along the study corridor from which the data was collected. The team observed vehicles avoiding an intersection on Arsenal Street by taking Taylor Street. She summarized the findings from the signal inventory taken from 14 signalized intersections along the corridor and issues were noted at all locations. The team will release a list of short-term recommendations to resolve these issues.

Ms. Castelli explained that the project team reviewed MassDOT statewide crash data and the District 6 Average Crash Rate (ACR). She showed a map of the top crash locations along the corridor. One of the state's top 200 crash intersections is in the study corridor (Galen Street/Nonantum Road/Watertown Street). There are several crash clusters within the corridor that are Highway Safety Improvement Program (HSIP) eligible, such as the unsafe pedestrian crossing in the Watertown Square area. Ms. Castelli noted that the most recent MassDOT crash data is from 2011-2013, but newer crash data from other sources (Watertown Police Department) is similar. She summarized the locations within the study corridor that exceed the District 6 ACR, and the majority of crashes appear not to be caused by speed or weather.

Ms. Castelli presented the traffic count data observed by project staff on the corridor and traffic cameras. She showed maps of turning movements and traffic volumes during AM and PM peak hours, and a table of daily traffic counts. Watertown Square has the highest traffic volumes. Ms. Castelli explained that the project team uses a VISSIM model to analyze traffic patterns. VISSIM is a simulation computer software that can track delays and show the interaction between vehicles, bicycles, and pedestrians.

Ms. Castelli reviewed the Measures of Effectiveness (MOE) for evaluating traffic. The two main MOE are delays and queues, which are not always related. Ms. Castelli showed a map of intersection operations along the corridor. Birmingham Parkway and Watertown Square are the most congested areas in the corridor with the lowest Level of Service (LOS). She provided images of sample average traffic queues in Watertown Square and Birmingham Parkway.

Question: Steve Magoon, Town of Watertown asked how cut-through traffic is measured for traffic volume data. Ms. Castelli said that there is no quantifiable data for cut-through traffic, but the project team will consider the routes that drivers are taking to avoid segments of Arsenal Street (such as using School Street, Taylor Street, Louise Street, and Beechwood Avenue) during the alternatives development. Ms. Castelli said the team's goal is not to discourage drivers from doing this, but rather to encourage them not to and to take Arsenal Street instead.

Comment: Peter Centola, Town of Watertown, said that there are many intersections with a "no turn on red" restriction that are unnecessary. Ms. Castelli thanked him for his comments.

Question: Mr. Bockian asked if it is too late for the team to include Greenough Boulevard and North Beacon Street in the study. Ms. Castelli said yes, it is too late, but the team will be able to observe traffic on these streets at a qualitative level.

Ms. Castelli presented the Existing Conditions Evaluation for bicycles and pedestrians. Most of the sidewalks in the corridor are in good condition, with some areas of deficiencies. Wheelchair ramps were inventoried along the corridor. There are many ramps that can be made ADA compliant with short-term fixes. Ms. Castelli showed a map of bicycle paths and lanes on and near the study corridor. She also showed turning movement and traffic volume data for bicycles and pedestrians during morning and evening peak hours.

Question: A participant asked what percentage of the total traffic volume data included bicycles and pedestrians. Ms. Castelli and Ms. Chan were not certain, but estimated a very low percentage, probably 1% for bicycles and 2-3% for pedestrians. Most bike and pedestrian traffic is crossing the study area.

Question: Rep. Hecht asked if bicycle and pedestrian numbers include those who use the community path. Ms. Castelli said no, but the team could place a counter on the path.

Question: Rep. Hecht asked if the crash data include accidents involving pedestrians and bicyclists. Ms. Castelli said yes. Any accident involving a vehicle reported to the police or the Registry of Motor Vehicles is included in the data. Pedestrian/bicycle crashes are often not included if they did not involve personal injury.

Comment: Mr. Magoon commented that the volume of pedestrian and bike traffic is so low because there is not much incentive for them on the corridor. The team could consider creating more opportunities for them in the alternatives development. Ms. Castelli agreed and noted that the residential and commercial development along the corridor may change these numbers as well.

Ms. Castelli reviewed ongoing improvements to bicycle and pedestrian accommodations, such as the Greenough Boulevard Riverfront Park Restoration and the Watertown Community Path.

Ms. Castelli presented the Existing Conditions Evaluation for the socioeconomics and demographics of the corridor. She reviewed population and employment data, the top locations where Watertown residents travel to work, and locations from where Watertown employees are traveling. Ms. Castelli noted that current trends indicate there will continue to be a shift in employment from manufacturing and industrial jobs to office, research & development, and service jobs. Ms. Castelli showed pie charts of the transportation modes used by Watertown residents and workers. The vast majority drive alone to work. Ms. Castelli showed a map of the current land use in the study area, which shows the boundaries for the population data used by the project team.

Ms. Castelli reviewed the limited environmental resources and constraints along the corridor, and stated that none are expected to have a significant effect on the alternatives development.

Question: Mr. Bockian asked if demographics of the corridor, including age, have an effect on the study. Ms. Castelli said yes, and explained that age tends to influence transit use.

Ms. Castelli summarized the available public health data. The data available is being used to create a baseline health profile that will be considered during alternatives development, with the goal of improving public health. She reviewed the various public health barriers facing the study area residents based on the existing built environments.

Ms. Castelli presented the data sources that are used in the 2040 Future Conditions report, and the development projects on and near the corridor that are being considered. She explained that the next Working Group meeting will focus more on the 2040 Future Conditions.

Ms. Castelli reviewed the Next Steps for the project, and noted the upcoming public meeting to be scheduled in February. The next Working Group meeting will be in early spring.

Question & Answer Session

Comment: Gideon Schreiber, Town of Watertown, suggested adding the residential development on the corridor to the Development Projects map and slide. Ms. Castelli thanked him for his comment.

Question: Andreas Aeppli asked if the study is looking at the potential for future development. Ms. Castelli said that RKG is taking a broad look at the corridor in its land use/economic analysis and will include what could happen in the future, but VHB is focused on what is already slated to happen.

Question: A participant asked if the study has the capacity for different future conditions scenarios. Ms. Castelli said there will only be one 2040 land use condition analysis.

Comment: Mr. Field said that study should definitely develop different scenarios for future conditions. Ms. Castelli said the team will be cautious and assume more will happen rather than less. VHB will take land use and zoning information into consideration. Mr. Heidelberg stated that Boylston Properties has data that he could share with Ms. Castelli.

Question: Ms. Falkoff asked what happens after the implementation of short-term recommendations, and who is accountable for implementing them. Ms. Castelli said the project will continue with alternatives analysis. Short-term recommendations can be implemented more quickly. Ms. Castelli believes the Town of Watertown would be accountable. Mr. Magoon said the Town will have these conversations with MassDOT in the near future.

Question: Mr. Magoon asked if the study is considering technology changes, such as self-driving cars. Ms. Castelli said yes, the alternatives development will consider possible effects of technology changes. Most of the alternatives will be focus on improvements to transit, bicycles, and pedestrians. The roadway capacity on Arsenal Street is limited, so expanding the road will probably not be viable.

Question: Mr. Bockian asked if the study is considering the impact on Arsenal Street if the Arsenal Street Bridge were to undergo reconstruction. Ms. Castelli said she has not heard of any plans to reconstruct the bridge, but if that were to happen it would primarily be a traffic management challenge, and would likely not change the capacity of the bridge.

Question: Rep. Hecht said the Arsenal Street Bridge is a nightmare for bicycles and pedestrians, and asked if there would be a future analysis for the Western Avenue side of the bridge. Ms. Castelli said the study team is aware of the poor bike and pedestrian conditions on the bridge. The study will be in touch with all surrounding communities to share current development plans, but will not ask each community what *might* happen in the future. She noted a representative of the Town of Waltham is present.

Comment: Rep. Hecht suggested that the study invite Harvard and the City of Cambridge to be involved in the study. Ms. Castelli thanked him for his comment.

Question: Melissa Santucci Rozzi, Watertown Zoning Board of Appeals, asked if there is background growth data available. Ms. Castelli said the study team is taking a very realistic look at growth, which is why they are using three different sources.

Question: Ms. Izzo asked if the study is considering eliminating some of the stops on Route 70 and 70A. Ms. Castelli said stop consolidation and traffic signal reconfiguration will be explored more thoroughly during alternatives development. Mr. Groth and Ms. Castelli explained that accessibility is an impediment to removing or consolidating stops.

Comment: Christine Dwyer and Jami Lard, Perkins School for the Blind, commented that there are drainage problems by the Arsenal Mall bus stop that are impeding accessibility to wheelchairs. Ms. Castelli thanked them for the comment, and said the study team has shared their findings from the wheelchair ramp inventory with the Town of Watertown on what needs to be fixed.

Question: A participant asked why 75% is the MBTA standard for on-time service. Ms. Castelli explained this is to account for unpredictability. Mr. Groth stated that this standard is measured differently for buses and rapid transit. Vincent Piccirilli, Watertown Town Council, commented that the MBTA should change their metrics and measure what the average customer would want from its service in order to enact changes in mode choice.

Question: An attendee asked what will be covered at the first public meeting. Ms. Castelli said the presentation will cover a high level existing conditions report. The team will ask the participants to decide what is important to them.

Question: Ms. Santucci-Rozzi asked if there is historic data the study can use to observe a change in different modes. Ms. Castelli said there is not much data available regarding bicycle and pedestrian growth that is older than what the team is currently using.

Comment: Mr. Field suggested that the team present counts of boardings and alightings along Arsenal Street at the public meeting. Ms. Castelli thanked him for his comment.

Ms. Castelli and Mr. Clark thanked the Working Group for attending and concluded the meeting.

ARSENAL STREET
CORRIDOR STUDY

Arsenal Street Corridor Study - Public Meeting #1: Summary

February 24, 2016, 6:00 – 8:00 PM, Watertown Middle School, 68 Waverley Avenue, Watertown, MA

Attendees

Michael Clark, Massachusetts Department of Transportation (MassDOT) Office of Transportation Planning (OTP); Laura Castelli, Caroline Ducas, Elsa Chan, Niki Hastings, Kristine Wickham-Zimmerman, Ken Schwartz, VHB; Nancy Farrell and Sarah Paritsky, Regina Villa Associates (RVA); elected officials; and members of the public (see attendance).

Meeting Purpose

The purpose of this first public meeting on the Arsenal Street Corridor Study was to introduce the study, provide an overview of the study framework and work completed to date, and gather public feedback. The presentation from the meeting is posted on the study website at: www.mass.gov/massdot/arsenalstreet

Meeting Summary

Introductions

Nancy Farrell, RVA, opened the meeting and welcomed attendees. She reviewed the meeting guidelines and emergency procedures. Michael Clark, MassDOT Project Manager, reviewed the meeting agenda and provided an overview of the project team, led by VHB and Project Manager Laura Castelli. RVA is managing the public involvement process and RKG Associates Inc. is providing economic development support. He noted that some members of the Working Group were in attendance.

Study Process

Ms. Castelli provided an overview of the study background and purpose. The topic of this meeting is the evaluation of existing conditions of multimodal transportation along the Arsenal Street corridor. The study is focusing on transit services, but will also propose improvements to pedestrian, bicycle, and vehicular traffic.

The study is focusing on the Arsenal Street corridor in Watertown and its connection to regional communities. Ms. Castelli described the local study area, which consists of 20 intersections along Arsenal Street between Watertown Yard and Birmingham Parkway. The regional study area includes portions of Watertown, Waltham, Cambridge, and Newton. The study team is collecting quantitative data for the local study area, and qualitative information for the regional study area. Maps of both areas are included in the meeting handout (available for download from the study website).

Ms. Castelli explained that the study is currently in the issues evaluation phase. She noted the Public Involvement Plan, from the study's framework phase, is a living document and will be continuously updated. The study began in September 2015 and will continue through March 2017. Comments are welcome throughout the process, but there will be a 30-day comment period on the final report at the end of the study.

Goals, Objectives, & Evaluation Criteria

Ms. Castelli reviewed the study goals and referred attendees to the handout for the complete set of objectives and evaluation criteria. Woven throughout the study goals are a number of public health elements.

Public Involvement

Ms. Castelli said the study includes numerous opportunities for public involvement, including six Working Group meetings and three public meetings. A project website includes a link to sign up for email updates. Ms. Castelli described the role and members of the Working Group, who include representatives from state and local agencies, elected officials, businesses, Perkins School for the Blind, and several civic and community organizations.

Existing Conditions Evaluation

Ms. Castelli said the town of Watertown has approximately 5,710 residents, 2,740 households, and 6,630 jobs. The corridor includes some residential parcels, a large number of industrial parcels, and many proposed residential developments. The employment in Watertown is shifting from industrial to commercial and office sectors. Residents and employees of Watertown primarily use a personal vehicle to commute to work; very few walk or ride a bicycle.

Ms. Castelli introduced Caroline Ducas, VHB, to describe the existing transit characteristics and infrastructure. Ms. Ducas highlighted the MBTA bus routes 70 and 70A, which travel through the corridor and connect with many MBTA bus routes at Watertown Square and Watertown Yard. Ms. Ducas said the schedules and frequency of service offered on the 70 and 70A indicate that most riders check the schedule before leaving for the bus.

Ms. Ducas summarized the condition of bus stops in the corridor. Most consist of posted signs only, but covered shelters are provided at the Watertown and Arsenal Mall stops. There are frequently narrow sidewalks and utility boxes and other obstacles in the sidewalks near the bus stops, which create accessibility problems. The busiest areas for boardings (when passengers get on the bus) and alightings (when passengers get off the bus) occur at the western and eastern ends of the corridor.

Ms. Ducas explained that passenger loading indicates how crowded the bus is, and is based on MBTA's current *Service Delivery Policy*. The MBTA defines the maximum average acceptable load as 54 passengers during peak periods, which means all seats are taken and some passengers are standing in the aisle. The maximum average acceptable load is 39 passengers, indicating the seated capacity is at 100 percent. Ms. Ducas noted Routes 70 and 70A fail the current MBTA loading standards during the early morning (inbound direction) time period. Route 70 also fails during midday school (inbound), evening (inbound and outbound), and night/sunrise (inbound) periods.

Ms. Ducas described the transit vehicle load maps for the corridor at different times of day. Key considerations for next steps include a closer look at passenger loading data, schedule adherence, passenger hours of delay, and travel time variability, all of which assess how reliable the bus routes are currently. Ms. Castelli noted that the MBTA's *Service Delivery Policy* will be changing soon, and the MBTA will host public meetings on that topic.

Ms. Castelli stated that the existing conditions will set the baseline for the alternatives comparison and analysis. The study team has collected daily traffic volume counts during morning and afternoon peak periods. Ms. Castelli described maps showing multimodal demands and "person trips" at key locations. About 85 percent of users are in cars and 14 percent are on the bus. The buses make up less than one percent of vehicles traveling along the corridor, indicating that more bus ridership would allow more people to pass through the corridor.

The study team looked at the condition of traffic signals at each intersection along the corridor. Any issues with the signals can be included in the study's short-term improvements list and the Town may try to fix these issues soon. One issue was already resolved at Watertown Square.

Ms. Castelli described the intersections of Galen Street at Watertown Street/Nonantum Road and Watertown Square. On average, queues at one intersection cause backups at the other. A signal issue at Arsenal Street was also fixed.

The study team reviewed crash data from MassDOT's list of top 200 crash locations, the Highway Safety Improvement Program (HSIP) funding eligibility, and MassDOT's Crash Database maintained by the Registry for Motor Vehicles (RMV). Ms. Castelli explained that the bulk of crashes are not caused by geometry, but rather driver impatience at unsignalized intersections. Ms. Castelli identified some intersections that are the highest priority from a safety perspective, including Watertown Square.

Ms. Castelli described the condition of pedestrian accommodations in the corridor. While there are sidewalks on both sides of Arsenal Street, width is an issue on the outbound side, especially for people with disabilities. The study team conducted an inventory of curb ramps for their compliance with the Americans with Disabilities Act (ADA). Some ramps could be upgraded at a relatively low cost. The close vicinity of Perkins School for the Blind, a member of the Working Group, reinforces the need for safe, accessible sidewalks. Ms. Castelli said there is a fairly good network of bicycle accommodations along the Charles River, with some plans for extensions.

Ms. Castelli noted that there are limited environmental resources in the study area that are not expected to affect the development of alternatives. However, each alternative will be evaluated for its impacts to natural and historical/cultural resources and hazardous materials.

Ms. Castelli described the study's public health assessment, which Ken Schwartz of VHB, is available to discuss further after the presentation. She said the rates of obesity and inactive living are rising faster in Watertown than in the rest of the state. Ms. Castelli reviewed the primary public health contributors, including access to public transit and pedestrian and bicycle facilities, and primary public health barriers, including bus services at or over capacity and insufficient pedestrian safety features.

Next Steps

Looking ahead, Ms. Castelli said the study team will develop the 2040 future conditions and identify issues, opportunities, and constraints before it develops and analyzes alternatives. The third Working Group meeting will be scheduled in early spring and the second public meeting will be held in summer 2016.

Question & Answer Session

Ms. Farrell said the study team is taking notes and will post the presentation and summary to the website after the meeting. She opened the floor to questions from elected officials.

Aaron Dushku, Watertown Town Council, thanked MassDOT for initiating this study. He is interested in changes to the MBTA bus routes 70 and 70A, based on a Cambridge Transportation Management Association (TMA) blogger's proposal. Ms. Castelli said she is aware of this idea and understands it has morphed into a parallel project. She will coordinate with the MBTA in the spring about it. Philip Groth, MBTA Service Planner, said the MBTA is considering a split between routes 70 and 70A. He added that major service changes like this are typically only approved during a Service Plan update.

Councilor Dushku commented that the new commuter rail station at Boston Landing in Brighton is not currently directly linked to bus routes. Mr. Groth said the MBTA is looking into this and sees the value in a direct connection.

Ms. Farrell opened the floor to questions and comments from all attendees.

Joe Levendusky, Watertown Public Transit Task Force (WPTTF), expressed his concern about the sustainability of the levels of car versus transit usage. He said the low transit user numbers are a testament to the poor service of MBTA buses. He suggested that the study conduct a survey of households asking what it would take to get drivers out of their cars and onto public transit. Mr. Levendusky noted that the loading numbers are skewed since one packed bus may be followed by an empty bus, which affects the average. He personally avoids taking the 70 bus due to its poor service. Mr. Clark thanked Mr. Levendusky for his comments and suggestions, and said MassDOT would also like to encourage the use of public transit. This is consistent with statewide goals in increasing mode share and decreasing greenhouse gases. Ms. Castelli added that the data speaks to the current *Service Delivery Policy* and alternatives will speak to the study's goals and objectives, GreenDOT, and the Healthy Transportation Compact.

Steve Owens asked how the limits of the regional study area were determined, and why Allston is not included. He noted the Boston Redevelopment Authority has plans for Allston, and Watertown is a destination for Allston residents. Ms. Castelli said the study team uses the regional study area to understand developments surrounding the corridor that will impact travel mode volumes. It could be expanded to include Allston.

Maria Saiz, Watertown Bike/Ped Commission, said she was excited to learn about the study. She asked if MassDOT will consider growth in the corridor and the traffic and parking studies conducted by developers. Ms. Castelli confirmed the study team is taking developments into account and using the Central Transportation Planning Staff (CTPS) regional model for growth. These will be shared at the next public meeting. Ms. Saiz added that the corridor is bad for biking; since there is not enough room, many people ride their bikes on the sidewalk. It can be tedious to cross back and forth when there is not a bike path on the same side of the street near School Street. It is also uncomfortable to walk through the corridor due to sidewalk widths and obstacles. Ms. Saiz suggested that the corridor needs visual appeal and beauty. Ms. Castelli said she agrees and acknowledged the problems Ms. Saiz described. Ms. Castelli suggested that there may be partnership opportunities between athenahealth, Boylston Properties, and the Town to improve the bike amenities. Ms. Castelli added that aesthetics can also be tied to the public health assessment.

A participant said that Somerville is implementing 12-foot wide sidewalks and asked if this is possible on Arsenal Street. Ms. Castelli said this would tie in with MassDOT's Complete Streets policy. The study team will consider whether expanding the sidewalk within a limited right-of-way is possible.

Vincent Piccirilli, a member of Watertown Town Council reported that athenahealth is applying for a grant to improve infrastructure on Arsenal Street, Beacon Street, and Greenough Boulevard. The Town Council is studying the idea of burying the power lines with other funding (approximately $15 to $18 million over five to 10 years), to help improve the pedestrian experience. Ms. Castelli noted that athenahealth has offered to share data with the study team.

Rachael Sack said she lives on Frank Street, parallel to Arsenal Street and North Beacon Street. She echoed earlier comments about complete streets and shared her concerns about speeding cars and buses on Arsenal Street. Ms. Sack said her neighborhood has families with young kids and Perkins School for the Blind. Drivers use Frank Street for access between Arsenal Street and North Beacon Street. Ms. Castelli said the width of the road affects speeds, which would lower if the road is narrowed. She said the study team will investigate traffic volumes on cut-through streets. It is difficult to discourage drivers from taking cut-through streets, but there are measures MassDOT can take to make it a less desirable option.

Andre Compagne, Watertown Bike/Ped Commission, suggested the study team consider the connection to the Watertown/Cambridge Greenway once it is finished, as it will bring more bike cross-traffic. Ms. Castelli agreed the study team will take cross-traffic, and not just linear traffic, into consideration.

Ilana Mainelli explained there is no place (kiosk or station) for her to add value to her Charlie Card in Watertown. When she adds value to her card on the bus, she realizes it holds up the entire bus. Ms. Mainelli added that she does not think the bus follows the schedule. She was later informed that she can add value to her Charlie Card online. Ms. Farrell thanked her for her comments.

Mr. Dushku shared his ideas about alternative ways to pay fares, in addition to Charlie Cards. Using a cell phone to pay would make it easier and promote more ridership. Mr. Dushku supported the idea of 12-foot wide sidewalks, a bus rapid transit lane, and bike path. He also suggested MassDOT consider using North Beacon Street for transit, since space on Arsenal Street is limited. Ms. Castelli said the study team will consider these ideas but cautioned that it would be difficult to accommodate each one of the requests participants had raised over the course of the meeting. As the study moves forward and alternatives are proposed, a discussion concerning prioritization of possible improvements within the available roadway right of way may be necessary.

Kathy Martin said she lives in the Arsenal Park Condominiums, a 36-unit building with apartments that house elderly and infirm people. She said some of the residents in wheelchairs travel on the road because of the poor sidewalk condition. Ms. Martin said she rides her bike and avoids Arsenal Street at all costs because of safety concerns. Her husband was in a bicycle/car crash at Arsenal Street and Greenough Boulevard. Ms. Martin proposed the idea of a shared lane for buses and bikes only. She added that she walks instead of taking the 70 bus.

Mr. Levendusky endorsed the idea of a shared lane on Arsenal Street for buses and bikes from the Charles River to Watertown Square. He suggested MassDOT consider a small physical barrier to separate the shared lane from the rest of traffic. He added that former General Manager Bev Scott said that

Charlie Cards were a “money sink” for the MBTA. Mr. Levendusky said sometimes bus operators don’t collect cash fares because they do not want to wait and hold up the rest of the bus.

Ms. Farrell thanked participants for attending and concluded the meeting.

Attendance

Connie Brown
Gordon Brown
William N. Brownsberger, Massachusetts Senate
Bruce Coltin
Andre Compagne, Watertown Bike/Ped Commission
Bill Conroy, Boston Transportation Department
Aaron Dushku, Watertown Town Council
Susan Falkoff, Watertown Town Council
Larry Field, Massachusetts Smart Growth Alliance (MSGA)
Philip Groth, MBTA Service Planning
Nancy Hammett
Jonathan Hecht, Massachusetts House of Representatives
Coriana Hunt Swartz, Watertown Public Transit Task Force (WPTTF)
Janet Jameson
Joe Levendusky, WPTTF
Anna Mackay, Guerrilla Development
Steven Magoon, Town of Watertown, Department of Community Development and Planning (DCDP)
Ilana Mainelli
Kathy Martin
Steve Owens
Anthony Palomba, Watertown Town Council
Mark Peterson, WPTTF
Vincent Piccirilli, Watertown Town Council
Rachael Sack
Maria Saiz, Watertown Bike/Ped Commission
Melissa Santucci Rozzi, Watertown Zoning Board of Appeals
Gideon Schreiber, Watertown DCDP
Adam Sennott, Watertown Tab
Matt Shuman, Town of Watertown, Department of Public Works
Pat Sullivan, 128 Business Council
Elodia Thomas

ARSENAL STREET
CORRIDOR STUDY

Arsenal Street Corridor Study Working Group Meeting #3: Summary

June 28, 2016, 9:30 AM, Watertown Free Public Library, 123 Main Street, Watertown, MA

Purpose

The purpose of the third working group meeting for the Arsenal Street Corridor Study was to review future conditions, including traffic forecasts, and introduce existing and projected issues and opportunities.

Present

Ethan Britland and Michael Clark, Massachusetts Department of Transportation (MassDOT) Office of Transportation Planning (OTP); Laura Castelli, Caroline Ducas, Niki Hastings, and Dan Sade, VHB; Gregory Flanigan and Sarah Paritsky, Regina Villa Associates (RVA); and the following members of the Working Group:

Andreas Aeppli, Resident
Andrew Bettinelli, Senator William Brownsberger's office
Jonathan Bockian, Watertown Public Transit Task Force (WPTTF)
Ray Dupuis, Watertown Police Department
Aaron Dushku, Watertown Town Council
Christine Dwyer, Perkins School for the Blind
Susan Falkoff, Watertown Town Council
Lisa Feltner, Watertown Town Council
James Freas, City of Newton
Philip Groth, MBTA
John Hawes, Watertown Planning Board
Rep. Jon Hecht, Massachusetts House of Representatives
Coriana Hunt Swartz, WPTTF/Flat Earth Theatre
Emily Izzo, Office of Representative Lawn
Jaimi Lard, Perkins School for the Blind
Steve Magoon, Town of Watertown
Roberta Miller, Arsenal Center for the Arts
Vincent Piccirilli, Watertown Town Council
Melissa Santucci Rozzi, Watertown Zoning Board of Appeals
Gideon Schreiber, Town of Watertown
Matt Shuman, Town of Watertown

Meeting Summary

MassDOT Project Manager Michael Clark opened the meeting and provided an overview of the agenda. He introduced Laura Castelli, VHB Project Manager, and led a round of introductions.

Niki Hastings, VHB, presented the data her team received from the Central Transportation Planning Staff (CTPS) based on the regional travel demand model. Data includes land use growth in Watertown, growth of trips by all modes, transit boardings for the Massachusetts Bay Transportation Authority (MBTA) bus routes 70 and 70A, and total vehicle trips for each roadway. Ms. Hastings stated that the model shows a 22% increase in daily transit ridership and approximately 1,640 additional weekday boardings on the 70/70A lines from 2015 to 2040. The model also showed renewed growth for walking and biking by 30 to 35% for each peak period. Vehicular growth averaged five to six percent.

Caroline Ducas, VHB, presented the 2040 transit analysis, first by reviewing the quantitative transit analysis metrics based on previous Working Group feedback on existing conditions. Ms. Ducas reminded the Working Group that the MBTA Service Delivery Policy standards are 54 riders during peak periods (which assumes some standing passengers) and 39 riders during non-peak periods (everyone has a seat). Ms. Ducas shared the results of applying the CTPS-modeled percent ridership growth for the 70/70A lines based on MBTA-provided ridership data from October 2015. Ms. Ducas compared existing and future passenger loading for:

- Entire Route 70/70A, weekday inbound
- Arsenal Street Corridor only, weekday inbound
- Entire Route 70/70A, weekday outbound
- Arsenal Street Corridor only, weekday outbound

In general, Ms. Ducas explained that a higher number of trips will exceed the current MBTA Service Delivery Policy standard by 2040. On overloaded trips, a higher percentage of stops will exceed the standard by 2040.

Before presenting the corridor travel time increases, Ms. Ducas explained that a bus route's travel time is the summation of the run time (movements from one stop to the other) and dwell time (time stopped to load and unload passengers). The study team modeled the corridor run time increase using VISSIM simulation software and modeled an increase in run time based on the MBTA-provided data. Ms. Ducas noted the MBTA is in the process of changing its fare collection policies. Proposals include all-door boarding and the elimination of cash payments, both of which would help decrease dwell times. Ms. Ducas detailed the expected corridor run time increase on inbound and outbound Route 70/70A buses by 2040 between Watertown Square and the intersection of Market Street/Western Avenue.

Question from Andreas Aeppli: Did you calculate corridor run times for buses in Central Square? Ms. Ducas explained the data is only focused on impacts to the study corridor.

Ms. Castelli presented the 2040 traffic analysis and explained that her team applied the 5% total background growth rate to existing traffic volumes throughout the corridor. She also took into account traffic expected to result from specific developments. The total resulting traffic growth rates are approximately 17% during the AM peak hour and 21% during the PM peak hour, but Ms. Castelli noted this varies throughout the corridor. These higher rates are a reflection of the growth specific to the Arsenal Street Corridor, and were incorporated into the output from the CTPS model.

Ms. Castelli noted the significant residential developments will also result in higher numbers of pedestrians, which factors into the alternatives development. If, for example, the team proposes changes to traffic signals, it needs to understand how an increase in pedestrians and bicyclists should be accommodated.

Question from Jonathan Bockian, Watertown Public Transit Task Force: Did this study incorporate origin and destination data or take into account singular versus multiple occupancy vehicular traffic? Ms. Castelli responded that there was no origin/destination study, but the team separated work trips from home trips. Philip Groth, MBTA, said he is using MBTA and Massachusetts Institute of Technology (MIT) origin and destination data for the 70 and 70A which he will share with Ms. Castelli.

Question from Jonathan Bockian, Watertown Public Transit Task Force: Are this study's growth rates consistent with the findings in the recent Northeastern University/A Better City study? Ms. Castelli said yes, that study included the same regional 5% growth rate for Middlesex County.

Question from Rep. Jon Hecht: Does transit data take into account development-specific growth? Ms. Castelli responded that yes, the run time assessment includes development-specific growth. The majority of development studies looked only at vehicular trips.

Ms. Castelli described the results of 2015 and 2040 traffic analysis maps. If there are no major improvements to the corridor, by 2040 there would be an increase in the number of intersections operating at a poor level of service, particularly in the eastern portion of the corridor. This is largely a result of inefficient operations of traffic signals that do not accommodate pedestrians well.

Ms. Castelli reviewed the map of opportunities and constraints, which was distributed to all meeting participants. She summarized corridor-wide issues, such as traffic signal deficiencies and a lack of pedestrian and bicycle amenities, and corridor-wide opportunities, such as transit signal priority (which would give buses priorities at traffic signals) and relocation of bus stops.

Ms. Castelli presented a list of all alternatives under consideration and noted that at the next meeting (later in the summer) the Working Group will discuss the screening of these alternatives:

#	Type	Alternative
1	Bicycle	Bicycle accommodations: On-road, east of School Street
2	Bicycle	Bicycle accommodations: Off road, connections to the Charles River
3	Bicycle	Bicycle accommodations: Cross connectivity between the Watertown Greenway and the Charles River
4	Bicycle	Bicycle accommodations: Separated bike lane east of School Street
5	Multi-modal	Road diet east of School Street (1 lane each direction, with transit lane/ bike facility)
6	Multi-modal	Soldiers Field Road Gateway Improvement (including placemaking)
7	Multi-modal	Watertown Square Gateway Improvement (including signal improvements)
8	Multi-modal	Traffic signal optimization
9	Multi-modal	Wayfinding (for all modes)
10	Transit	Bus Rapid Transit (BRT) along North Beacon Street
11	Transit	Transit Signal Priority (includes potential to eliminate/ relocate bus stops)

12	Transit	Watertown Square Bus Alternative
13	Transit	Evaluation of transit stop pull-out feasibility
14	Transit	Transit shelter feasibility evaluation
15	Transit	Transit service improvements to existing bus routes
16	Transit	Consolidated shuttle service along Arsenal Street
17	Vehicle	Adaptive Signal Control
18	Vehicle	Overhead lane indication signage

Ms. Castelli explained that Adaptive signal control ties multiple signals together and gives flexibility for cycle time based on congestion. She reviewed locations that need immediate improvements due to high frequencies of accidents, and do not need further planning. A safety audit could be arranged with members of the community, police and fire departments, and town officials to look at problems in these locations and brainstorm solutions.

Ms. Castelli identified intersections that have pedestrian phase or other signal deficiencies. She noted that there are 37 ramps that need only a tactile warning strip to be compliant with the Americans with Disabilities Act (ADA), which is a lower cost and level of effort for the Town. Other ramps, however, would need full reconstruction to become compliant.

Ms. Castelli reviewed the next steps for the project, which includes continued alternatives development and the first level screening. The next Working Group meeting will be scheduled in late July or early August, with a second public meeting in late September.

Question & Answer Session

Question from Steve Magoon, Town of Watertown: Is the recommendation to coordinate signals throughout the corridor or in separate groups within the corridor? Ms. Castelli said it is preferable to coordinate signals corridor-wide in the future, though the eastern half of the corridor could be coordinated today (more immediately). Adaptive signal control appears to be a good option. Mr. Magoon asked about burying utilities which is particularly challenging due to the Cambridge aqueduct. Ms. Castelli said this would need to be evaluated further and could be a challenge for that reason. At the very least, the team will recommend moving utility poles from the middle of the sidewalk.

Question from Gideon Schreiber, Town of Watertown: Is it possible to restructure the 70/70A bus routes and add more buses to help improve transit service? Ms. Castelli said alternative #15 (above) proposes changes to existing bus service to improve capacity. De-coupling the 70/70A is a separate MBTA project and will help inform this study.

Comments from Aaron Dushku, Watertown Town Council: A Master Plan is being developed in conjunction with athenahealth and other developments, so this study's recommendations should be shared with athenahealth. Mr. Dushku expressed his support for adaptive signal control and transit signal priorities. He recommended prioritizing bike safety in metro areas with on-road bike accommodations and signalized bike crossings. Ms. Castelli described some of the challenges of bike signals, including when riders don't obey the signals. She said this can be discussed at further meetings.

Comments from Mr. Groth: The MBTA is piloting transit signal prioritization in Cambridge and Brookline, so Mr. Groth will provide recommendations for equipment purchases.

Comments from Lisa Feltner, Watertown Town Council: Ms. Feltner expressed her support for pedestrian safety and concern with aesthetics of overhead signs and signals. Ms. Castelli said the team will recommend general streetscape and aesthetics for overall improvements to improve the pedestrian experience, which could include ornamental signal heads.

Question from Mr. Bockian: What is the relationship between opportunities and alternatives? Ms. Castelli explained the opportunities were used to develop the alternatives, and screening criteria (shared at the first Working Group meeting and already incorporates the Working Group's feedback) will be used to narrow down the alternatives.

Question from Susan Falkoff, Watertown Town Council: What are the advantages of an articulated bus? Ms. Castelli explained that articulated buses can seat more passengers (47 to 57 seats compared to 39 in regular buses) and bend in the middle to make turns.

Comment from Ms. Feltner: Bike share, such as Hubway, is desirable for the corridor. Ms. Castelli said the study team can recommend Hubway locations and/or propose a joint venture with athenahealth or Boylston Properties (for example). Ms. Feltner added that the intersection of Birmingham Parkway, North Beacon Street and Arsenal Street needs improvements. Ms. Castelli said the team is looking into tying these signals together and fixing broken equipment.

Question from Mr. Magoon: How can we factor autonomous vehicles into the alternatives? Ms. Castelli said there are many perspectives on autonomous vehicles and it can be difficult to plan for them.

Comments from Melissa Santucci Rozzi, Watertown Zoning Board of Appeals: Ms. Santucci Rozzi expressed her concern regarding bike conflicts and safety, and emphasized the need for an educational component to the alternatives. Ms. Castelli agreed and said this is a widespread issue. With better accommodations, bicyclists are more likely to follow signals. Ms. Santucci Rozzi also discussed gridlock and the impatience of drivers trying to avoid waiting multiple traffic signal cycles. "Don't block the box" signs and pavement markings can help educate drivers.

Comments from Vincent Piccirilli, Watertown Town Council: athenahealth is investing $25 million into improvements at the river crossing; this effort should be taken into account by the study. Ms. Castelli said she is coordinating with athenahealth and will incorporate the mitigation program once it is finalized.

Comments from Rep. Hecht: Can the Town work with the individual developers and the study team to keep everyone coordinated? Rep. Hecht requested an emphasis on pedestrian improvements and making the corridor more welcoming to pedestrians. He noted the example of people driving across the street in the Alewife area. Ms. Castelli said pedestrian improvements are part of the multimodal alternatives. Rep. Hecht asked about right-of-way (ROW) impacts and Ms. Castelli said after ROW impacts are identified, if the town wanted to proceed with recommendations, the Town would work directly with property owners. Rep. Hecht suggested increasing connectivity across the corridor by creating connections on private development sites. He asked if alternatives can encourage mode shift and Ms. Castelli replied that the project team can identify the alternatives that have the highest likelihood to encourage mode shift, but a complete analysis will not be covered under this study. Mr. Groth noted that mode shift is complicated, but the MBTA does have an elasticity model based on economic ridership projections.

Comment from Mr. Schreiber: The Town of Watertown is working on conversations with private property owners about easements, especially for mixed use developments.

Comment from Roberta Miller, Arsenal Center for the Arts: Safety is a priority, as well as connections to and through the corridor and to the greenway. Ms. Miller expressed her support for alternative #3 (see table above). Mr. Schreiber added that athenahealth is looking at connections to the greenway on the company's property.

Comment from Christine Dwyer and Jami Lard, Perkins School for the Blind: Alternatives should focus on pedestrians with vision impairments, including a localized shuttle to the Arsenal Mall.

Comment from Mr. Dushku: Alternative #5 is a big change and may have impacts to automotive traffic, but it could solve a lot of problems for pedestrians and bicyclists. Ms. Castelli said the project team will evaluate the benefits and drawbacks of each alternative, including impacts to traffic volumes in the neighborhood. Any major infrastructure alternatives that have Working Group and public support would move forward in a separate public process.

Question from Mr. Aeppli: Will you consider more passive traffic management methodologies? Ms. Castelli said the team is considering this as an alternative, including the potential for a traffic circle at the river crossings.

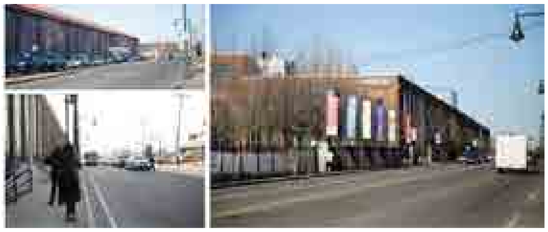
Question from Mr. Bockian: If the goal is to reduce congestion, how can you evaluate alternatives without considering the effects of mode share? Ms. Castelli explained the alternatives will be evaluated based on the current distribution of modes, and will consider a 20% growth in vehicles and 30% in non-motorized modes. The town is also looking at household and employment growth. Mr. Groth noted that cost, time, safety, and comfort are all factors that play into mode choice. Mr. Clark explained that the evaluation criteria will be used to assess the alternatives, including effects on mode share. The team will qualitatively assess improvements; a quantitative assessment is burdened by the number of variables in play, given the team must use the available resources to focus on the Arsenal Street corridor.

Question from Mr. Dushku: What is the status of the MBTA service planning process, and can the evaluation of the 70/70A routes tie into the new commuter rail station process? Mr. Groth replied that the Fiscal and Management Control Board (FMCB) will discuss the service plan update at the next meeting. There is supposed to be service plan update every two years but the last one was over six years ago. Mr. Groth explained it can be difficult to add buses to the 70/70A without taking them from elsewhere. The MBTA is looking into rapid transit options at Boston Landing.

Comment from Ms. Feltner: The intersection of Walnut Street and School Street, near Arsenal Street, should be examined for new connections to Watertown Square.

Mr. Clark thanked the Working Group for attending and providing comments, and he concluded the meeting.

ARSENAL STREET
CORRIDOR STUDY



Arsenal Street Corridor Study Working Group Meeting #4: Summary

August 3, 2016, 9:30 AM, Watertown Free Public Library, 123 Main Street, Watertown, MA

Purpose

At the fourth Working Group meeting, the project team presented the results of the first level alternatives screening process, as well as short-term recommended improvements. A preview of alternatives analysis was also discussed.

Present

Ethan Britland and Michael Clark, Massachusetts Department of Transportation (MassDOT) Office of Transportation Planning (OTP); Laura Castelli and Niki Hastings, VHB; Emily Christin and Sarah Paritsky, Regina Villa Associates (RVA); and the following members of the Working Group:

Andreas Aeppli, Resident
Jonathan Bockian, Watertown Public Transit Task Force (WPTTF)
Pat Connolly, athenahealth
Aaron Dushku, Watertown Town Council
Christine Dwyer, Perkins School for the Blind
Susan Falkoff, Watertown Town Council
Lisa Feltner, Watertown Town Council
Jeff Heidelberg, Boylston Properties
Rep. Jon Hecht, Massachusetts House of Representatives
Emily Izzo, Office of Representative Lawn
Jaimi Lard, Perkins School for the Blind
Steve Magoon, Town of Watertown
Roberta Miller, Arsenal Center for the Arts
James Piccirilli, Town of Watertown
Vincent Piccirilli, Watertown Town Council
Gideon Schreiber, Town of Watertown
Matt Shuman, Town of Watertown

Meeting Summary

MassDOT Project Manager Michael Clark opened the meeting and provided an overview of the agenda. He provided a recap of the previous Working Group meeting and led a round of introductions. He introduced Laura Castelli, VHB Project Manager.

Ms. Castelli reviewed the 18 potential alternatives that were presented at the previous meeting, as well as the goals and objectives of the study. She noted that the study goals, objectives, and evaluation criteria are included on the handout. Ms. Castelli explained that each alternative was measured against the previously established goals and objectives in the preliminary screening process.

Ms. Castelli and Niki Hastings, VHB, presented the results of the preliminary screening process. Each alternative falls into one of the following categories: bicycle, multi-modal, transit, or vehicle.

Bicycle Alternatives

1. Bicycle Accommodations On-Road, East of School Street – ***advanced***
    - Ms. Castelli said this will have the least impact to private property along the corridor, and it could balance well with future and current development projects. She added that the next step of screening will identify the exact square footage of potential impacts to private properties. She said that this may be combined with Alternative 4 for a "hybrid alternative."

2. Off-Road, Parallel Connections to Charles River – ***discarded***
    - Ms. Castelli said there would be grade issues with this option, and therefore it was discarded in favor of connections to the river to the south (Alternative 3).

3. Cross Connectivity Between Greenway and River – ***advanced***
    - Ms. Castelli showed a map of potential pathways connecting to the river. She said that a typical cross section and potential impacts to private property would be developed in the next stage of the screening.

4. Separated Bike Lanes East of School Street – ***discarded***
    - Ms. Castelli said the project team analyzed four roadway alignments for this alternative which included widening the road in different directions. Ms. Castelli presented sample impact analyses, including widening to the north only, widening to the south only, and widening to the north and south. Each alignment had significant impacts to private properties, and would require reconstruction of the Arsenal Street bridge over the Charles River. Ms. Castelli said that reconstructing the bridge would involve Massachusetts Environmental Policy Act (MEPA) permit approvals and would be a significant undertaking; therefore, all bike lanes recommended for the study will likely end at the bridge. She added that it is possible there may be room for separated bike lanes in small sections along the corridor, but would only be implemented if the sections are long enough to minimize transitions between on- and off-road locations.

    - **Question from Gideon Schreiber, Town of Watertown**: Has the project team considered narrowing the vehicle lanes along the corridor in order to accommodate bike lanes (a road diet)? Ms. Castelli said that a road diet will be evaluated as part of a separate alternative, but noted that reducing the number of travel lanes would have operational impacts to traffic and would likely induce cut-through traffic on parallel corridors.
    - **Question from Lisa Feltner, Watertown Town Council**: Are there any connections for bicycles under consideration on Arsenal Street to Watertown Square from the Walnut Street area? Ms. Castelli said this would have fallen under Alternative 2, which was discarded. She also noted that the Town is currently developing options to extend bicycle connections west. Ms. Feltner added that the Town has plans for a bike route to continue up Arsenal Street using Taylor Street.
    - **Question from Matt Shuman, Town of Watertown**: Has the project team considered shared use paths in any alternatives? Ms. Castelli said the one of the alternatives includes shared use paths, but it has the same impacts to the buildings between School

Street and Birch Road as Alternative 4. Mr. Shuman said that he would favor pedestrian needs over bicycle accommodations, and suggested looking at North Beacon Street and Greenough Boulevard as alternative bicycle routes because they do not have as many traffic lights. He added that the Greenough Boulevard and Arsenal Street intersection is unsafe for pedestrians. Ms. Castelli said that all of the sidewalks have been looked at in this study, and that even though sidewalks line both sides of Arsenal Street, they are not always functional or compliant with the Americans with Disabilities Act (ADA) due to tree pits and utility poles. She said that the study team will identify any utility poles recommended for relocating.

- **Comment from Mr. Schreiber:** There are restrictions to relocating many of the utility poles along Arsenal Street because of the Cambridge waterline**.** Ms. Castelli thanked him for sharing that information.
- There was a discussion about the possibility of other bicycle connections to the Charles River from the 311 Arsenal Street building. Jeff Heidelberg, Boylston Properties, added that DCR did not like the plans for bicycle paths through the middle of the Boylston Properties property because of steep slopes. He added that DCR indicated that they would prefer a bicycle and vehicle connection from the Arlington Street intersection to Greenough Boulevard. Mr. Schreiber added that there is an existing connection through Arsenal Park that the Town is looking to improve. He also discussed several connections that athenahealth is considering.

Multimodal Alternatives

5. Road Diet East of School Street – ***advanced***
    - Ms. Castelli said that this would reduce the roadway from four to two lanes. She explained that while this would improve the public health along the corridor in general, it could result in traffic diversions to other local neighborhood roads, which may negatively impact the public health of residents.

6. Soldiers Field Road Gateway Improvements – ***advanced***
    - Ms. Castelli said the study team has observed inefficiencies and safety hazards at this intersection and extending west to the intersection of Arlington Street/Coolidge Street. Potential improvements for this extended gateway include pedestrian accommodations, lane striping, and signal timing/phasing.

7. Watertown Square Gateway Improvements – ***advanced***
    - Ms. Castelli said improvements could include signal timing/phasing, intersection geometry (lane usage), and eliminating or rerouting legs of the Square.
    - Bus operational changes will also be considered.

8. Traffic Signal Optimization – ***discarded***
    - Ms. Castelli said that signal timing improvements are being progressed independently as part of development projects, so it is redundant for this alternative to remain.

9. Wayfinding – ***discarded***

- Ms. Castelli said this will be incorporated into the bicycle recommendation, as it is ineffective in meeting the study goals on its own.

- **Question from Aaron Dushku, Watertown Town Council**: If bike/bus lanes are added, would they offer travel in each direction? Ms. Castelli said yes, there would be one in each direction.
- **Question from Mr. Dushku**: Transit Signal Priority (TSP) is being considered for the Mount Auburn Street corridor. At this last meeting, didn't the study team indicate that TSP was infeasible? Ms. Castelli explained that TSP is a challenge for the MBTA at the moment because the agency would have to add the capability on all buses, but one of the alternatives includes assisting the community in implementing TSP once the MBTA is ready. She clarified that "signal optimization" just includes timing/phasing of traffic signals.
- **Question from Steve Magoon, Town of Watertown**: Has the study team looked at the impact to the traffic capacity of Arsenal Street if TSP is implemented? Ms. Castelli said TSP might hold a green light longer to allow a bus to pass through, which might delay the vehicles on the side streets at the red light, but the system can recover fairly quickly. She clarified that TSP may be able to assist buses that are behind schedule. She said this discussion can be continued at the next Working Group meeting with Philip Groth, the MBTA representative for the Working Group.
- **Question from Jonathan Bockian, Watertown Public Transit Task Force**: Is better signage being considered for Watertown Square? Ms. Castelli said yes. Mr. Bockian asked how lane capacity is calculated with buses if the ideal capacity is 900 passenger cars per lane, per hour. Ms. Castelli said the lane capacity converts buses to passenger cars when determining the ideal capacity.

Transit Alternatives

10. Bus Rapid Transit (BRT) along North Beacon Street – ***advanced***
    - Ms. Hastings said further analysis will be done to see if sufficient ridership would warrant BRT, and that connections to commuter rail will be considered.

11. Transit Signal Priority (TSP) – ***advanced***
    - Ms. Hastings said further analysis would include changes that would be required to accommodate TSP, including queue bypass lanes and bus stop consolidation.

12. Watertown Square Bus Alternative – ***discarded***
    - Ms. Hastings said this was discarded to be incorporated into the Watertown Gateway Improvements alternative.

13. Transit Stop Pull-Out Feasibility – ***advanced***
    - Ms. Hastings said further analysis would be done to qualitatively assess impacts to travel time, as well as identify spatial constraints for pull-outs.

- **Comment from Mr. Magoon**: Will the buses actually use a pull-out, as not all bus drivers do? Ms. Castelli said the study team will need to consider the effectiveness of pull-outs and consult the MBTA.

14. Transit Shelter Feasibility – ***advanced***
    - Ms. Hastings said further analysis would consider the impacts of adding shelters to 11 stops along the corridor. She showed the screening summary that was completed on the 11 potential bus stops.

15. Transit Service Improvements to Existing Bus Routes – ***advanced***
    - Ms. Hastings said this alternative will look into splitting the current routes into three smaller, separate routes, and combining Route 70A with other existing routes. Further analysis would include a qualitative assessment of improvements to travel time and on-time performance.

16. Arsenal Street Consolidated Shuttle Service – ***discarded***
    - Ms. Hastings said this alternative was discarded due to a lack of data to determine whether a shuttle service would be operational along the corridor. She noted that this alternative could be considered at a later date once several shuttles are operational.

- **Question from Mr. Dushku**: Are off-board fare collection stations being considered? Mr. Clark explained that is not being advanced at this time because the MBTA is working towards a system-wide strategy.
- **Question from Mr. Schreiber**: How is the physical space being determined for shelters? Is it in the study's right-of-way? Mr. Clark said the study team will be looking at individual capacity for a shelter at each stop, but it is ultimately the MBTA's decision regarding the space and design of the shelters.
- **Comment from Ms. Feltner**: Bus shelters and off-board fare collections stations would be a good amenity to add close to the new housing developments being constructed. Mr. Schreiber added that the existing bus stops are not necessarily where they should be located long-term, so if off-board fare collection stations are being considered, the Working Group should think about where bus stops should be located in the long-term. Mr. Clark said the team will consider this when determining if pull-outs and shelters should be implemented.
- **Comment from Mr. Bockian**: A connection to the Green Line/Packards Corner should be considered if BRT is to be looked into further. Ms. Hastings thanked him and said the team will look into this possibility, and that Brighton Avenue is constrained.
- **Comment from Mr. Schreiber**: The lack of connection to the Longwood Medical Area is a huge issue for Watertown residents. It currently takes about an hour and a half to get there via public transit, so a possible connection to Longwood from Watertown Square would be extremely beneficial as it is a large employment center.
- **Question from Representative Jon Hecht**: How does the study team measure how much more volume of traffic could be moved with BRT compared to existing service? Ms. Hastings said the next steps of analysis would help the team understand this better,

and it would include measuring the local population and the potential draw/attraction that a BRT would have. She noted that this study will not be evaluating the impacts to traffic operations and that a more detailed analysis would need to be studied further.

- **Question from Andreas Aeppli**, **Watertown resident**: Would the BRT line be able to exist just in Watertown, or would it have to be extended to be a complete BRT service? Ms. Hastings said that the length of the route will be determined in the next step of the analysis. Mr. Aeppli asked if there is currently bus service in Brighton to Packard's Corner. Mr. Clark mentioned Route 57, and noted that Route 65 terminates in Brighton Center, which could be a potential connection at Boston Landing.

Vehicles Alternatives

17. Adaptive Signal Control – ***advanced***
    - Ms. Hastings said further analysis would include studying the fluctuations in traffic flow, and if adaptive signal control is a good candidate for the corridor. There was a discussion of the safety improvements proposed by athenahealth.

18. Overhead Lane Indication Signage – ***discarded***
    - Ms. Hastings said this could be incorporated into the Watertown Square Gateway Improvements alternative.

Ms. Hastings presented a list of expedited (short-term) recommendations, which are low-cost and can be advanced immediately. The recommendations include road safety audits based on the Highway Safety Improvement Program (HSIP) locations, traffic signal improvements, and curb ramp improvements such as tactile warning strips for ADA compliance.

Ms. Hastings presented a preview of how the alternatives that were recommended for advancement will be evaluated. Next steps include assessing the level of support from the public and Working Group and identifying potential funding sources. She referred to the handout, which includes a blank alternatives evaluation matrix. She explained that the alternatives will be assigned as having a positive, neutral, or negative impact to each criteria.

Mr. Clark reviewed the next steps for the project, such as the analysis of the advanced alternatives. There are two Working Group meetings left, including one in late fall after the next public meeting in late September. The Working Group will also have an opportunity to comment on the final report when it is released in the late winter or spring of 2017.

Question & Answer Session

Comment from Vincent Piccirilli, Watertown Town Council: It is important for the MBTA to see the results of this study and understand that Watertown needs better public transit service. Mr. Dushku added that the study should take a holistic approach in improving accessibility and mobility for all transportation modes, and there needs to be increased reliability as well as enhancements for pedestrians around the bus stops. Mr. Clark said the study team will evaluate the alternatives based on better transit service.

Question from Mr. Dushku: Will the study be looking into pedestrian enhancements in the Watertown Square bus stop area, such as new public space? Ms. Castelli said the study will identify those spaces for potential public use but will not develop specific plans.

Question from Mr. Bockian: How will this study proceed after it is complete? Who is responsible for implementing the alternatives? Ms. Castelli said the study team will present the final analysis, but it is ultimately up to the Working Group and the community to decide what to move forward with. The study team will lay out the technical information and next steps for environmental permitting processes if necessary. She added that in her previous experience, the best options usually rise to the top based on financial constraints, and what is most popular with the Working Group and the public. Mr. Clark added that it is largely a consensus decision with the Town, as it is the primary owner of the corridor right-of-way. Ms. Castelli said the team will help identify timelines for alternatives, such as what can be done in the next three to five years versus what can be done in the next 10 years.

Comment from Rep. Hecht: It would be useful to identify packages of alternatives that should be grouped together. Ms. Castelli said she hopes that will become clear as the analysis proceeds. The group may choose which alternatives are most attractive first, then decide to group some of those ones together.

A discussion followed regarding the possibility of coordinating with Transportation Management Associations (TMAs) and express buses to high transit priority locations such as South Boston and the Waterfront. Rep. Hecht said the new developments along the corridor may be interested in funding TMAs, and that the MBTA should not be relied upon solely for improving transit service.

Mr. Clark thanked the Working Group for attending and providing comments, and he concluded the meeting.

ARSENAL STREET
CORRIDOR STUDY

Arsenal Street Corridor Study - Public Meeting #2: Summary

October 4, 2016, 6:00 – 8:00 PM
Watertown Middle School, 68 Waverley Avenue, Watertown, MA

Attendees

Michael Clark, Massachusetts Department of Transportation (MassDOT) Office of Transportation Planning (OTP); Laura Castelli, Caroline Ducas, Elsa Chan, Niki Hastings, Kristine Wickham-Zimmerman, VHB; Nancy Farrell and Sarah Paritsky, Regina Villa Associates (RVA); elected officials; and members of the public (see attendance).

Meeting Purpose

The purpose of the second public meeting on the Arsenal Street Corridor Study was to present future year transportation conditions, issues and opportunities identified along the Arsenal Street corridor, and selected alternatives to be analyzed further, and to gather public feedback. The presentation from the meeting is posted on the study website at: www.mass.gov/massdot/arsenalstreet

Meeting Summary

Introductions

Nancy Farrell, RVA, opened the meeting and welcomed attendees. She reviewed the meeting guidelines and emergency procedures. Ms. Farrell noted that immediately following the presentation, the project team will move to the cafeteria to discuss the alternatives with attendees in more details, answer questions, and ask for their input. Michael Clark, MassDOT Project Manager, reviewed the meeting agenda and introduced Niki Hastings, VHB, who presented the development of 2040 Future Conditions.

2040 Future Conditions

Ms. Hastings explained that the study team collected data on future conditions for the year 2040 to ensure anything the study recommends will address future needs.

Regional Travel Demand Model

The study team worked with the Central Transportation Planning Staff (CTPS), an arm of the Boston Regional Metropolitan Planning Organization (MPO), which maintains a regional travel demand model. Ms. Hastings explained that the CTPS model is based on assumptions for 2040 household and employment growth, and enables the team to develop land use growth data in Watertown, growth of trips by all modes, transit boardings for the Massachusetts Bay Transportation Authority (MBTA) bus routes 70 and 70A, and total vehicle trips for each roadway.

Ms. Hastings stated that the model shows a 22% increase in daily transit ridership and approximately 1,640 additional weekday boardings on the 70/70A lines from 2015 to 2040. Vehicular growth averaged 5% during morning (AM) and afternoon (PM) peak periods.

Transit Analysis

Caroline Ducas, VHB, presented the 2040 transit analysis. She explained that the study team took feedback from the first public meeting and from the Working Group to develop quantitative transit analysis metrics: one to indicate the number of trips with crowding and one to understand the congestion and impact of delays on bus travel times. Ms. Ducas shared the results of applying the CTPS-modeled ridership growth for the 70/70A lines based on MBTA-provided ridership data. Ms. Ducas compared existing and future passenger loading for:

- Entire Route 70/70A, weekday inbound
- Arsenal Street Corridor only, weekday inbound
- Entire Route 70/70A, weekday outbound
- Arsenal Street Corridor only, weekday outbound

In general, Ms. Ducas explained that there are overcrowded conditions on the bus routes today, but the project area will worsen if no improvements are made to the corridor.

Ms. Ducas defined a bus route’s travel time as the summation of the run time (movements from one stop to the other) and dwell time (time stopped to load and unload passengers). She noted that the MBTA is studying approaches for fare payment and the potential for an all-door boarding policy, both of which could affect corridor run times. The study team modeled the corridor run time increase using VISSIM simulation software and modeled an increase in run time based on MBTA-provided data from 2015. Ms. Ducas shared an example of the corridor run time increase for the Route 70/70A between Watertown Square and Market Street/Western Avenue. A substantial increase is anticipated due to congestion and intersection signal delays.

Traffic Analysis

Ms. Castelli presented the 2040 traffic analysis and explained that her team applied the 5% total background growth rate to existing traffic volumes throughout the corridor. She also took into account traffic expected to result from specific developments. The total resulting traffic growth rates are approximately 17% during the AM peak hour and 21% during the PM peak hour. Ms. Castelli referenced other improvements planned by proponents of some of the developments in the corridor, including a two-way bike path being added to the north side of Arsenal Street.

Ms. Castelli then described the results of 2015 and 2040 traffic analysis maps. She said there are currently intersections with a level of service (LOS) E or F at each end of the corridor. If there are no major improvements to the corridor, by 2040 there would be an increase in the number of intersections operating at a poor level of service, particularly in the eastern portion of the corridor.

Issues, Opportunities & Constraints

Ms. Castelli reviewed the map of issues, opportunities, and constraints. She noted this map can be reviewed in more detail during the Open House portion of the meeting.

Alternatives Development

Ms. Castelli presented a list of 18 alternatives that were considered and noted that some of them have been discarded from further analysis for various reasons. She continued to explain which alternatives were discarded and the reasons they failed to advance. The alternatives that are moving forward were discussed in further detail during the Open House. Each alternative falls into one of four categories: bicycle, multi-modal, transit, or vehicle.

Bicycle Alternatives

1. Bicycle Accommodations On-Road, East of School Street – ***advanced***
   - Ms. Castelli said this alternative involves an on-road bike lane.

2. Off-Road, Parallel Connections to Charles River – ***discarded***
   - Ms. Castelli said there are opportunities for cross-connections with bicycle accommodations along the Charles River to the south (Alternative 3).

3. Cross Connectivity between Greenway and River – ***advanced***
   - Ms. Castelli showed a map of potential pathways connecting to the river and welcomed suggestions on where the cross connections should be explored further.

4. Separated Bike Lanes East of School Street – ***discarded***
   - Ms. Castelli said the project team analyzed four roadway alignments for this alternative, which included widening the road in different directions.
   - Ms. Castelli presented a sample impact analysis that has significant impacts to properties including historic buildings, which are very close to the street.
   - The study team is exploring opportunities to fit bicycle accommodations onto the existing roadway, but it is possible there may be room for separated bike lanes in small sections along the corridor. This would only be implemented if the sections are long enough to minimize transitions between on- and off-road locations.

Multimodal Alternatives

5. Road Diet East of School Street – ***advanced***
   - Ms. Castelli said that this would reduce the roadway from four to two vehicular lanes (one in each direction). The other lanes would be dedicated to bikes or buses, or both.
   - This has benefits for non-motorized travelers and transit, but the team is still studying what kinds of impacts a road diet would have to traffic on neighborhood roads.

6. Soldiers Field Road Gateway Improvements – ***advanced***
   - Ms. Castelli said the study team is considering some ideas that will be shared during the open house portion of the meeting.
   - She mentioned that the Department of Conservation and Recreation (DCR) owns a lot of the land near the intersection, so the Town would coordinate with DCR to alleviate traffic in this location.

7. Watertown Square Gateway Improvements – ***advanced***

- Ms. Castelli said the study team has some ideas for signage to help with lane management. This could reduce the number of last minute merges that currently complicate travel at this intersection.

8. Traffic Signal Optimization – ***discarded***
    - Ms. Castelli said that signal timing improvements are being progressed independently as part of development projects, so it is redundant for this alternative to remain.

9. Wayfinding – ***discarded***
    - Ms. Castelli said this will be incorporated into other alternatives, as it is ineffective in meeting the study goals on its own.

Transit Alternatives

10. Bus Rapid Transit (BRT) along North Beacon Street – ***advanced***
    - Ms. Castelli explained that BRT or express transit service along multiple routes, with connections to Commuter Rail or the Red Line, is being considered. She described some potential challenges with this alternative due to width restrictions.

11. Transit Signal Priority (TSP) – ***advanced***
    - Ms. Castelli said TSP involves programming signals to adjust for buses by holding the traffic signal green phase if the signal detects a bus within a certain distance of the intersection.

12. Watertown Square Bus Alternative – ***discarded***
    - Ms. Castelli said this was discarded to be incorporated into the Watertown Gateway Improvements alternative.

13. Transit Stop Pull-Out Feasibility – ***advanced***
    - Ms. Castelli said this alternative addresses how the bus meets the curb. Either the bus leaves the travel lane or the curb comes into the roadway to decrease the time buses take to merge with traffic.

14. Transit Shelter Feasibility – ***advanced***
    - Ms. Castelli said the study team is considering the impacts of adding shelters to 11 stops along the corridor. There are locations where adding a shelter may not be possible due to the limited width of the sidewalk.

15. Transit Service Improvements to Existing Bus Routes – ***advanced***
    - Ms. Castelli explained that this alternative will explore the possibility of combining services and changing transit service in the corridor. The study team would hope that any recommended changes could be implemented at a low cost and on a short timeline.

16. Arsenal Street Consolidated Shuttle Service – ***discarded***

  - Ms. Castelli said this alternative was discarded because the developments are currently providing separate services. A transportation management association (TMA) could consolidate these services, but it is too premature to do so now.

Vehicles Alternatives

17. Adaptive Signal Control – ***advanced***
    - Ms. Castelli said this alternative involves the use of "smart" traffic signals to help manage the crossings of pedestrians and bicyclists, while improving the efficiency of travel for vehicles.

18. Overhead Lane Indication Signage – ***discarded***
    - Ms. Castelli said this could be incorporated into the Watertown Square Gateway Improvements alternative.

Ms. Castelli presented a list of expedited recommendations, which are low-cost and can be advanced immediately. The recommendations include road safety audits based on the Highway Safety Improvement Program (HSIP) locations, traffic signal improvements, and curb ramp improvements such as tactile warning strips for ADA compliance.

Next Steps

Ms. Castelli explained that the study team will continue the alternatives analysis this fall and will have draft recommendations ready by early next year. The next Working Group meeting will be scheduled this winter, with the next public meeting in spring 2017.

Question & Answer Session

Ms. Farrell opened the floor to questions.

Nicholas Anastasiades asked how the traffic forecasting was done. Ms. Castelli said the study team did traffic counts during the fall of 2015 but there are no permanent count stations. Forecasts were calculated by hand. Mr. Anastasiades expressed concerns with trucks traveling very fast along Arsenal Street, particularly near the Perkins School for the Blind. He suggested installing speed bumps to remind buses and trucks to slow down in that area. He also recommended installing a signal at the intersection of Louise Street and Arsenal Street.

Dorothea Hass, Walk Boston, commented about increasing time for bus trips that could be improved with traffic signal priority. Ms. Castelli responded that traffic signal priority is not included in the study's no build alternative, but it is an improvement alternative that the study team is evaluating. Ms. Hass said that pedestrians cross through the corridor throughout the day, sometimes to access bus stops across the street. Ms. Castelli said that a pedestrian phase will be included in each cycle at signalized intersections. It is most challenging to accommodate pedestrian crossings during peak hours. Ms. Hass commented that safety audits should include pedestrian wait times at intersections. She noted that Boston is building more protected bike lanes, including one on Massachusetts Avenue. Ms. Castelli explained that this is typically done by absorbing on-street parking, but there is no on-street parking on Arsenal Street east of School Street. In the future, bike accommodations will connect to an off-road bike path.

Lisa Feltner, Watertown Town Council, stated that the corridor can be thought of as a pedestrian/bicycle boulevard or a high-traffic vehicular throughway. She asked how the road diet would affect neighborhoods and stated Montreal has a successful model that protects residential streets from absorbing heavy traffic. Ms. Castelli said the study team does not have enough information yet, but the analysis will look at where traffic diverts if Arsenal is congested.

Aaron Dushku, Watertown Town Council, expressed his support for the BRT idea. He encouraged the study team to consider the new residences along the corridor and think about where the stops should be. Ms. Castelli said the analysis won't specify stops for the BRT, but the new residences are included in the ridership analysis. She noted the BRT alternative may evolve into an "express transit service."

A resident of Watertown commented that Arsenal Street is reduced to one lane due to ongoing construction. She said that the new mall is expecting 10,000 cars on a Saturday and mentioned other new developments, whose residents may choose to use their cars. Ms. Castelli agreed that the road is narrower near the current construction, but she said the four-lane section of Arsenal Street is also included in the analysis. Ms. Castelli noted that the study team will have more information about the road diet at the next public meeting in the spring. There will be a 30-day comment period once the draft Final Report is released, so residents will have another opportunity to provide feedback on the analysis then. Ms. Castelli explained that since the Town has jurisdiction over the road and decision-making, MassDOT would not construct something the Town does not support.

Anthony Palomba, Watertown Town Council, asked how the alternatives will help reduce the congestion on Arsenal Street today, not just in 20 years. Ms. Castelli said the study team is looking at the current situation but considers a date far off in the future to ensure the Town and State have a good return on their investments.

Mark Sideris, Watertown Town Council President, asked how to get the MBTA on board to increase capacity. Ms. Castelli explained that the MBTA is part of our Working Group. The study scope tells the team to ignore funding constraints, but the study team will take a realistic look and develop short and longer term options.

Rachael Sack asked for clarification about the growth projections. Ms. Hastings replied that corridor wide growth is projected at 20%. The team started with 5% based on employment and household growth for the region, but layered on the developments in the corridor and adjusted the results.

Ms. Farrell thanked everyone for attending and asked participants to move to the cafeteria for the open house portion of the meeting.

Open House

The study team staffed various tables around the room and described the alternatives in more details to participants. Attendees provided written comments on sticky notes that were placed on several boards at each table. A transcription of the comments is below. Additional participants recorded their feedback on comment forms and submitted them to the project team for consideration.

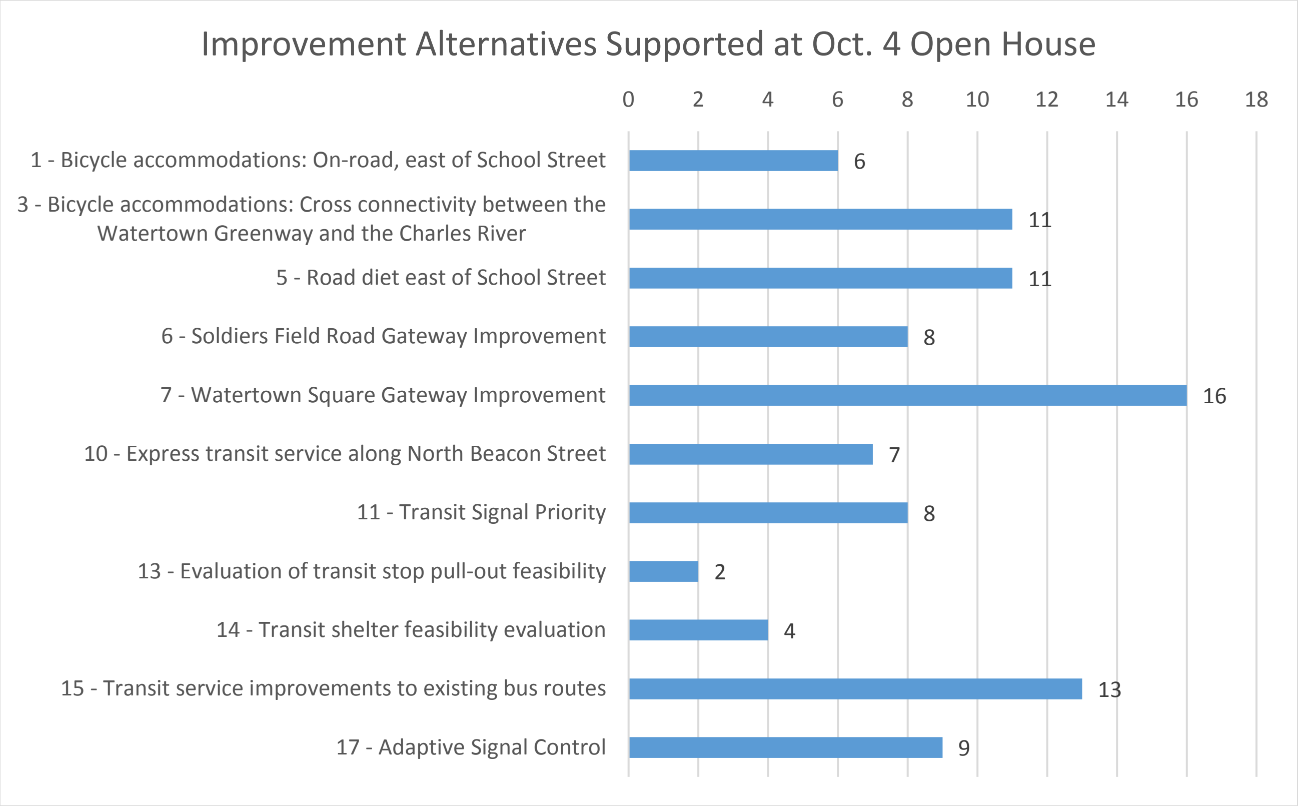
Table 1 – Comments from Open House

BOARD	**COMMENTS**
Existing MBTA Transit Routes	• I don't believe the traffic volumes. Too low, especially over 20 years. Need public transit; get out of cars.

BOARD	COMMENTS
	• Where is bike pedestrian connection IN to square? To river? • Not enough buses; already crowded; Watertown Square is messy, poles in the way; signage needed; bikes need signs too. • Slow traffic on Arsenal so cars yield to pedestrians. • Bus down North Beacon St as an alternative to the 70/70A → Market → Western Ave.
Issues and Opportunities Map	• Get OFF Arsenal; Taylor a problem for many reasons (where is bold thinking). • Bike path not just another lane not just “moving through.” • If road diet reduces to 1 lane, then what happens if there is an automobile accident? • North Beacon is a beautiful residential street with bike lanes… just saying.
Watertown Square Gateway Map	• Change Elm St 5-way. • Need bus shelters BIG TIME. • Reduce turning lanes in Watertown Square. Improve level of service for bikes and pedestrian and buses to reduce single occupancy vehicle trips. Inconveniencing motorists is okay. • Hooray for more green space! • Combine taxi/bus/bike lanes if can’t make nice paths. • Detailed studies of Watertown Square are great. Bold thinking would be welcome. • Alternatives, many alternatives would help. How about a rotary? Don’t forget the bikes.
Soldiers Field Road Gateway Map	• Smart lights at pedestrian crossings – lights that “see pedestrians.” • Arsenal to Western Ave is scary, trying to walk feels like SE Expressway. Dangerous. Pedestrians are vulnerable. • Difficult pedestrian crossing from Arsenal to Western, • Bike pedestrian convenience needs to be priority at Soldiers Field Rd; shorten crossings; “sharrows” and bike boxes at crossings reduce refuge islands and push buttons. • Why keep greenway “bifurcated” with roads. Realign Greenough-Arsenal-North Beacon.
2015 Traffic Analysis Results	• Slow traffic on Arsenal Street to 25 mph. • Want concurrent signalization with LPI (leading pedestrian interval). • Provide frequent safe pedestrian crossings on Arsenal. • Off-road bicycle lanes. • Why not Irving and Mount Auburn included? Irving is connection!
MBTA Routes 70/70A Arsenal Street Inbound Bus Stop Locus Map	• PLEASE do not have pedestrian crossing at same time traffic can turn – this slows traffic to a crawl and is very dangerous for pedestrians.

BOARD	COMMENTS
	- Get rid of 4-way pedestrian crossings! Worse for everyone involved. - Build real sidewalks wider so that two people can walk side-by-side. - Which cross connection makes it possible to walk to/from Arsenal N-S? - Drop utilities into the ground; get transformers and poles out of sidewalks. - Corridor should prioritize bus/bike lanes and easy pedestrian crossings in order to reduce demand for car travel. - Agree with above comment.
MBTA Routes 70/70A Arsenal Street Outbound Bus Stop Locus Map	- Get rid of light poles in way – stagger them differently? - Disappointed in bike path decisions, only looks School → east. Should be true off-road and/or connect to North Beacon.

After participants reviewed the improvement alternatives, they were encouraged to place up to four dots on a board listing the 11 options to express their support or indicate interest. A chart showing the results of the dot exercise is below.



Attendance

Nicholas Anastasiades
Charles Anastasiades
Chris Anastasiades
William Anastasiades
Ann Asnes
Jeff Bennett, 128 Business Council
Jon Bockian, Watertown Public Transit Task Force (WPTTF)
Charlie Breitrose, Watertown News
Jake Carmody, Vanasse & Associates Inc.
Anne Ciretta
Marcia Ciro
Anni Clark
Michelle Cokonougher
Joanna Duffy
Sandra Duran, Perkins School for the Blind
Aaron Dushku, Watertown Town Council
Mona Elou
Roger & Joanna Erickson
Wendy Etkind
Susan G. Falkoff, Watertown Town Council
Lisa Feltner, Watertown Town Council
Maureen Foley
Elliot Friedman, WPTTF
Philip Groth, MBTA Service Planning
Nancy Hammett
Dorothea Hass, Walk Boston
Jonathan Hecht, Massachusetts House of Representatives
Jeffrey Heidelberg, Boylston Properties
Carrie Huff Souto
Coriana Hunt Swartz, Flat Earth Theatre Company/WPTTF
Emily Izzo, Office of Rep. John J. Lawn, Jr.
Janet Jameson
Steve Kalmanides
Barbara Kim
Judith Kohler, WPTTF
Angeline Kounelis, Watertown Town Council
Kevin MacDonald
Steven Magoon, Town of Watertown, Department of Community Development and Planning (DCDP)
Kathy Martin
Karen McClosky
Gregory Mcfay
Bridger McGaw, athenahealth
Christopher McKenzie
Beth Miller
Anthony Palomba, Watertown Town Council
Deborah Peterman
Vincent Piccirilli, Watertown Town Council
Daniel Pryor
Sarah Ryan
Rachael Sack
Trey Sasser
Gideon Schreiber, Town of Watertown, DCDP
Sam Scoppettone, Watertown Bicycle and Pedestrian Committee
Libby Shaw
Mark Sideris, Watertown Town Council
Maryann Skahan
E. Jane Smith
Dave Sprogis, WPTTF
Susan
Elodia Thomas
Rav Trial
Eric Wlodyka

ARSENAL STREET
CORRIDOR STUDY

Arsenal Street Corridor Study Working Group Meeting #5: Summary

January 24, 2017, 9:30 AM, Watertown Free Public Library, 123 Main Street, Watertown, MA

Purpose

At the fifth Working Group meeting, the project team reviewed the October 2016 public meeting and presented the results of the alternatives analysis and preliminary recommendations.

Present

Michael Clark, Massachusetts Department of Transportation (MassDOT) Office of Transportation Planning (OTP); Laura Castelli, Caroline Ducas, and Michael Gordon, VHB; Kate Barrett and Sarah Paritsky, Regina Villa Associates (RVA); and the following members of the Working Group:

Andreas Aeppli, Resident
Andrew Bettinelli, Senator Brownsberger's office
Jonathan Bockian, Watertown Public Transit Task Force (WPTTF)
Craig Cashman, Representative Moran's office
Peter Centola, Town of Watertown
Ray Dupuis, Watertown Police Department
Aaron Dushku, Watertown Town Council
Courtney Dwyer, MassDOT
Lisa Feltner, Watertown Town Council
Larry Field, Massachusetts Smart Growth Alliance (MSGA)
James Fitzgerald, City of Boston
Tim Goodin, Office of Councilor Mark Ciommo, City of Boston
Philip Groth, Massachusetts Bay Transportation Authority (MBTA) Service Planning
John B. Hawes, Jr., Town of Watertown Planning Board
Rep. Jon Hecht, Massachusetts House of Representatives
Jeffrey Heidelberg, Boylston Properties
Coriana Hunt Swartz, WPTTF
Emily Izzo, Office of Representative Lawn
Shawn Kelly, athenahealth
Amitai Lipton, MassDOT
Bridger McGaw, athenahealth
Steve Magoon, Town of Watertown
Roberta Miller, Mosesian Center for the Arts (formerly the Arsenal Center for the Arts)
Vincent Piccirilli, Watertown Town Council
Melissa Santucci Rozzi, Watertown Zoning Board of Appeals
Gideon Schreiber, Town of Watertown
Matt Shuman, Town of Watertown

The following members of the public also attended: Doug Brown, Friends of the Greenway; Don Giller, New Red Theater; Michael Pompili, Worldtech Engineering; Sophie Schmitt, Livable Streets.

Meeting Summary

Kate Barrett, RVA, opened the meeting and stated that she will help keep the meeting on schedule, given the abundance of information that needs to be presented and discussed. MassDOT Project Manager Michael Clark provided an overview of the agenda and led a round of introductions. He introduced Laura Castelli, VHB Project Manager.

Ms. Castelli provided a brief recap of the October 2016 public meeting and open house. She described the results of a dot exercise conducted during the open house and noted that the transit stop pull-out and bus shelter alternatives received the least amount of interest. Ms. Castelli described the alternatives analysis methodology, which is based on the established study goals and objectives. The study team developed preliminary order-of-magnitude construction cost estimates; however, they will be discussed at the next (and final) Working Group meeting. Ms. Castelli added that this meeting will include a discussion of the alternatives analysis and preliminary recommendations for which alternatives should advance as short-, mid- and long-term recommendations.

Alternative 1: Bike Lanes East of School Street

Ms. Castelli explained that the project team originally considered bike, travel, and turn lanes that meet current minimum design standards, but they do not fit within the existing right-of-way (ROW) and would require widening the roadway. Due to existing constraints, narrowing sidewalks is not an option. Therefore, the team considered maintaining the existing curbs and narrowing the outside travel and turn lanes, with MassDOT's minimum bike lane width of 5 feet on the south side and a 4-foot bike shoulder on the north side. The alternative would cover School Street to Greenough Boulevard and meet up with the improvements required for athenahealth's mitigation. The second option would involve 5-foot bike lanes with a slight narrowing of the travel lanes between Talcott Avenue and Greenough Boulevard. Ms. Castelli presented several plans and welcomed questions and comments from the Working Group.

Comments from Matt Shuman, Town of Watertown: From a public works perspective, the lanes are wide now and he would not support anything less than 11 feet. In another part of town, the lanes were recently narrowed to 11 feet and the Town has received some push back from the public. The road carries a lot of truck traffic and oversized loads. Mr. Shuman supported providing a 4-foot shoulder for bicycles with minimum 11-feet travel lanes. He later added that the 4-foot bike shoulder is consistent with the improvements discussed with athenahealth.

Question from Aaron Dushku, Watertown Town Council: Has the team considered bike lanes with pylons to protect bicyclists from vehicles? Ms. Castelli said that would require additional space outside of the existing right-of-way. She also mentioned the related seasonal maintenance challenges.

Question and comment from Roberta Miller, Mosesian Center for the Arts: Is there data comparing the safety benefits of widening bike lanes versus vehicle lanes? Ms. Castelli agreed to look into the research on delineating travel spaces. Ms. Miller also suggested installing a rumble strip along the inner edge of the bike lane. Ms. Castelli said she will explore this but is aware of potential ice and noise issues.

Alternative 3: Cross Connectivity between the Watertown Greenway and Charles River

Ms. Castelli explained that the Town is in the process of identifying a preferred route connecting the Greenway and Charles River. She said the team could explore changing travel direction to northbound or southbound only for Louise Street, Beechwood Avenue, and Irving Street, but these decisions would require a separate public process with the Town and neighbors. Ms. Castelli noted the Fire Department prefers at least 18 feet to accommodate its vehicles. She explained that the public meeting feedback requested the consideration of cross-connectivity, and asked for feedback from the Working Group on which connections should be prioritized.

Comments from Lisa Feltner, Watertown Town Council: Changes to neighborhood streets need to be carefully discussed with residents. These streets are very important connections.

Comments from Mr. Dushku: One-ways could help improve connections in the area.

Comments from Gideon Schreiber, Town of Watertown: This could also create traffic issues and circling traffic on adjacent streets. Ms. Castelli said the project team has count data but she suggested the Town do an origin/destination study to look at traffic effects.

Question from Ms. Feltner: Will the study look at effects to side streets? Ms. Castelli replied yes, the study will examine effects to side streets.

Alternative 5: Road Diet East of School Street

Ms. Castelli presented two options for the road diet:

- One general travel lane and one shared bus-bike lane in each direction
- One general travel lane westbound and two general purpose and one bus-bike lanes eastbound

Ms. Castelli reviewed the roadway capacity threshold analysis which would result in 50% diverted traffic east of School Street, 23% diverted traffic east of the Arsenal Project main driveway, and 46% diverted traffic east of Arlington Street during the morning peak hour (in the future year of 2040). While some traffic would be diverted to other roads, a lot of traffic is destined for the corridor itself and there is a limited ability to divert regional trips. Ms. Castelli believes this would create congestion with safety implications and would result in complaints to the Town. She described a map with some potential parallel routes, which could create significant concerns for neighborhood streets.

Comments from Peter Centola, Town of Watertown: I support bike paths, but safety should be prioritized. I'm not sold on the road diet. Ms. Castelli advised him to consider the transit improvements as compared to the road diet improvements.

Questions from Ms. Feltner: What is the narrowest width for sidewalks? Ms. Castelli explained that the Americans with Disabilities Act (ADA) requirements are 5.5 feet (which includes curb and with 3 feet around obstructions) or 4-foot sidewalks with a 5-foot square every 100 feet. The existing sidewalks are substandard in a number of locations. Ms. Feltner asked why the year 2040 was considered. Ms. Castelli explained that the 2040 is within the typical planning period. She added that traffic estimates consider known redevelopments in the area for this timeframe.

Comments from Mr. Schreiber: The results show the reality of the road today. Many residents and employees are destined for Arsenal Street and a road diet could be a major issue for all of Watertown. Mr. Schreiber added that he has heard a shared transit/bike lane is not always a preferred option. Philip Groth, MBTA, said the MBTA prefers separate facilities but would not say no to a shared bus/bike lane.

Question from Representative Jon Hecht: How would the results be impacted by other alternatives? Ms. Castelli said though other alternatives could help reduce volumes and affect mode shift, each alternative is examined individually and none would fully ease the burden of the road diet.

Alternative 6: Soldiers Field Road Gateway Improvements

Ms. Castelli explained that the team began looking at potential intersection improvements and bypass roads to accommodate bicycles and pedestrians where Arsenal Street intersects with Soldiers Field Road. Such ideas include signal timing and phasing changes to allow for pedestrian crossings and repairs to signal equipment. MassDOT is coordinating separately with the City of Boston on private site developments at Western Avenue, and therefore the team has refocused on the Arsenal Street intersection with Arlington Street and Coolidge Avenue. Ms. Castelli described some existing problems at the intersection, which is confusing regarding who has the green light and lacks bicycle accommodations, and described two potential improvement options:

- Option 1: Signal phasing remains the same but ROW confusion is resolved; a new 40-foot wide road connects Arlington Street to Coolidge Avenue and accommodates all modes; Coolidge Avenue would be closed at Arsenal and Arlington Streets and Coolidge Avenue traffic would shift to Arlington Street. There are potential wetlands impacts so environmental permitting would be required.
- Option 2: Similar to Option 1, Coolidge Avenue would be closed at Arsenal and Arlington Streets; a new road connects Coolidge Avenue to Arsenal Street, providing better access for UPS but impacting private property. This would remove some traffic from the signal and would likely result in operational improvements.
    - **Comment from Mr. Schreiber:** There are wetlands in this area and therefore environmental permitting would be required.

Question from Vincent Piccirilli, Watertown Town Council: How much traffic in this area is related to UPS and Aggregate Industries? Ms. Castelli expects that a significant amount of traffic is related to these two businesses. There are times with high levels of truck traffic, but this varies by time of day. Ms. Castelli added that the team has count data for this location, but no specific counts related to UPS and Aggregate.

Alternative 7: Watertown Square Gateway Improvements

Ms. Castelli said the team has evaluated signal timing and phasing, signal coordination between the two intersections, lane use modification, pedestrian accommodation enhancements and the potential relocation of Charles River Road at Watertown Square eastward towards Riverside Street. The Route 70/70A eastbound bus stop could also be relocated closer to Watertown Yard and/or consolidated with another bus stop to improve operations. Ms. Castelli said the team considered the findings of MassDOT's recently completed Roadway Safety Audit (RSA), which suggested phasing and geometric changes at the Galen Street/Nonantum Road/Watertown Street intersection south of the bridge.

Ms. Castelli outlined the anticipated results of the proposed improvements to Watertown Square:

- Enhanced safety by eliminating an approach, improving approach/movement alignments, and modifying north/south phasing
- Improved queues, but possible increase in delay
- Improved pedestrian accommodations

- Does not fully address bike connectivity or mobility (not enough room for a dedicated space for bikes)

Comments from Mr. Dushku: More updates are needed to the Watertown Yard bus stop and driveway. Ms. Castelli replied that this is part of the RSA project and this project could only support those improvements or suggest further study. Mr. Schreiber encouraged Mr. Dushku to read the RSA report regarding pedestrian safety issues at Watertown Yard.

Comments from Mr. Centola: Orientation on the map is difficult. Where is the statue? Ms. Castelli helped Mr. Centola understand the map, noted the statue will not be impacted, and said she will add landmarks to the maps for the next meeting.

Comments from Ms. Feltner: Pedestrian safety is good, and bikes should be accommodated to the extent possible. Ms. Castelli noted the details will be fleshed out with community input.

Comments from Jonathan Bockian, WPTTF: Charles River Road changes would impact neighborhood cut-throughs. The new development at Irving Street has affected neighborhood traffic, particularly during peak periods. Please consider these types of impacts carefully. Ms. Castelli said the team is considering some of these impacts and encouraged the Town to consider these impacts during the design phase.

Comments from Mr. Groth: Drivers of Route 71 have issues with the catenary wires when turning right onto Main Street and left onto Mount Auburn Street. Alternatives should consider ways to improve this issue.

Alternative 10: Express Bus along North Beacon Street

Ms. Castelli explained this alternative is more of a hybrid of bus rapid transit (BRT) and an express bus. Routes from Watertown Square to Boston Landing (commuter rail connection) and further, to Packard's Corner (MBTA Green Line connection), were explored in coordination with Mr. Groth, MBTA, regarding service requirements. Ms. Castelli said that the preliminary ridership estimates generally support express service for the peak periods. She noted service between Watertown Square and Boston Landing could be a pilot program of the Watertown Transportation Management Association (TMA) and would likely require two buses to run. Ms. Castelli explained that the extension of service from Boston Landing to Packard's Corner adds about 1.6 miles and up to 22 minutes in both directions, which would require an additional one to two buses. At this time, the team is likely to recommend only pursuing service to Boston Landing. Particularly if private entities may step in to fund such service, the cost benefits of running to Packard's Corner may not be sustainable.

Question from Mr. Schreiber: Does an existing bus provide service from Boston Landing to Packard's Corner? Mr. Groth said Route 57 serves Packard's Corner and is about a three to five-minute walk from Boston Landing to the south.

A discussion of routing options followed with comments from various Working Group members. Ms. Castelli described that the reason for examining service to Watertown Square was primarily due to the potential ridership that route variation offered.

Question from Larry Field, MSGA: How many Watertown residents are commuting to South Boston? Ms. Castelli will follow up with the numbers and time to South Station. She estimated up to 20 percent of commuters could be headed to South Boston based on development there over the past 10 years. She will review whether American Commuter Survey data from 2010 shows any trends related to the increase in development. Mr. Dushku asked a similar question about commuter patterns to Boston University and the Longwood Medical area. Ms. Castelli agreed these are also hotspots for commuters.

Alternative 11: Transit Signal Priority (TSP)

Ms. Castelli said the team evaluated TSP using the VISSIM microsimulation model and highlighted some potential adjustments to bus stops to maximize its effectiveness. TSP would require bus transponders on all MBTA buses because the buses are switched throughout the MBTA system and not used solely for certain routes.

Comments from Mr. Groth: All buses are currently compatible with transponders. The MBTA is pursuing a pilot TSP project in Cambridge.

Ms. Castelli presented results of the model, which show that as much as 12 minutes could be saved during the peak hour in the outbound/westbound direction. TSP could result in additional travel time for vehicles that are held on side streets by lights or traffic queues. The team cannot recommend if TSP should include the Watertown Square and Soldiers Field Road gateways at this time due to the complexity of the model.

Comments from Mr. Dushku: Do the results consider the number of people (versus vehicle) per intersection? Ms. Castelli said the model focuses on bus operations (how a bus gets through the intersection) in order to determine the feasibility of the alternative. This includes the amount of time it takes to clear vehicle traffic in front of the bus. The alternative did not focus on throughput of one service versus another. Mr. Groth noted that studies show mixed benefits of TSP.

Comment from Mr. Schreiber: Each leg of Watertown Square has transit, so TSP for Route 70/70A could prioritize that service over the 71.

Comment from Ms. Feltner: Side street congestion is concerning.

Alternative 13: Transit Stop Turnouts/Curb Extensions

Caroline Ducas, VHB, explained spatial requirements and operational considerations for bus stop turnouts and curb extensions. Bus stop turnouts require the bus to exit the travel lanes, which benefits general traffic but negatively impacts transit operations due to the re-entry delay that can be caused by the need for the bus to merge back into the general travel lane. Because bus stop turnouts also require more physical width than is available at most stop locations on the corridor, no suitable locations were identified. Transit stop curb extensions are preferred for transit operations but would require the elimination of on-street parking or bike lanes and could negatively impact general traffic. For these reasons, Ms. Ducas said the team does not recommend transit stop curb extensions at any locations on the corridor.

Question from Mr. Bockian: How are the impacts of a curb extension different from the status quo? Ms. Ducas said currently the bus stops are in-line curbside stops, within the existing parking lane area in some locations on the corridor. Incorporation of curb extensions would further reduce on-street parking and limit the potential continuity of bike lanes along the corridor. Ms. Castelli and Mr. Groth described the concept of a floating bus stop, where a bike lane is routed around the bus stop.

Comment from Mr. Dushku: Fare collection at the bus stop, instead of onboard the bus, could help reduce dwell times but there is no guidance from the MBTA on this. Ms. Ducas described the MBTA's next generation of automated fare collection (AFC 2.0) which will allow all-door boarding. Mr. Groth said off-bus fare collection has very high costs for maintenance and installation. He said AFC 2.0 will also not accept cash, so boardings will be faster. Ms. Castelli said off-bus fare collection will not be included in the study while the MBTA is developing AFC 2.0.

Alternative 14: Transit Shelters

Ms. Castelli explained that for the 8 locations that meet the MBTA eligibility for transit shelters, 3 are not feasible due to potential conflicts with building faces, foundations, or underground utilities, and 5 would have minor to moderate property impacts (primarily to landscaping) that could be negotiated with the property owner.

Question from Mr. Piccirilli: Could we consider installing an awning over the sidewalk instead of a standard shelter where a shelter structure isn't feasible? Ms. Castelli said this would be possible if the property owner is willing to hang an awning off its building.

Alternative 15: Existing Transit Service Improvements

Ms. Ducas presented various potential transit service improvements, including routing adjustments and service frequency/schedule adjustments. The team considered adjustments to the termini of Route 70/70A and identified key ridership locations at Waltham Center, Watertown Square, the Watertown & Arsenal Malls, and Central Square. She stated that approximately 10 to 20 percent of passengers on any given trip would experience reduced service with a termini change to Waltham Center, with a greater number affected by a termini change further inbound.

Ms. Ducas described a route splitting option that includes a loop circulator that would operate between Waltham Center and North Waltham, and a trunk route that would operate between Waltham Center and Central Square. This option would also continue to run the existing Route 70. The team performed a trip chaining analysis to determine that the MBTA would need two additional buses in order to split the Route 70A into the loop circulator and trunk route, while maintaining existing Route70A service frequencies.

Question from Mr. Groth: Did you consider deadheads? Ms. Ducas said the team considered existing turn times and additional trips but did not look at crew shifts or contract issues. She said she would follow up with Mr. Groth to coordinate.

Ms. Ducas said the team performed an origin-destination analysis to determine that passengers on the loop circulator could benefit from a coordinated transfer to express service at Waltham Center to Central Square. Potential benefits of route splitting include improved reliability and on-time performance, more evenly distributed trunk service, reduced crowding, and reduced travel times with a transfer to express service.

Ms. Ducas described express service, which had support at the public meeting in October 2016 as an added service on top of existing local service. This additional express service would have far fewer stops than the existing service to reduce travel times (up to 9-10 minutes for some trips), improve reliability and on-time performance, increase capacity, and potentially induce new transit demand.

Ms. Ducas said the team explored modification of other transit routes and found that improving the connection to the Red Line via express service to Central Square can benefit substantially more riders than modifying other bus routes. There were no suitable changes identified to other routes due to crowding issues, increases in travel times if other routes were modified, and substantial infrastructure requirements and costs to extend other routes.

Finally, Ms. Ducas described service frequency and schedule changes that could benefit the 70/70A bus based on future 2040 conditions. She said the team recommends additional express (peak period) and local (off-peak) trips, as well as schedule shifts to improve headway consistency.

Question from Mr. Field: How many additional buses would be required to implement these changes? Ms. Ducas said this would depend on the number of additional trips. The initial schedule prepared for analysis purposes would require four additional buses to implement express service and the route splitting to accommodate future 2040 demands, but it will depend on the final package of improvements that are recommended.

Comments from Andreas Aeppli: The MBTA's long-term strategy could include changing the current bus style (2-door) to add additional doors and longer, articulated vehicles.

Question from Mr. Piccirilli: Could the express service be privatized, and if so, how many vehicles would be needed? Ms. Ducas said this would depend on the number of express trips, but at least two vehicles would likely be needed to operate express service during the peak hours. Mr. Groth said a timed transfer would benefit from the same operator and splitting the 70/70A would be the largest bus to bus transfer in the system; he would rather find a way for the MBTA to do it. Mr. Aeppli said privatizing express service would be a poor use of capital funds.

Comments from Mr. Schreiber: The express service would have a lot of riders from Watertown Square traveling to Central; perhaps it could eliminate an extension to Waltham. Mr. Schreiber suggested adding a stop at Perkins School for the Blind or at larger residential developments. Ms. Ducas described the balance of serving as many riders as possible without slowing down the service.

Alternative 17: Adaptive Signal Control (ASC)

Ms. Castelli considered various ASC technologies and discussed feasibility with Watertown staff. The primary infrastructure is generally in place. The system would have benefits along congested corridors and could help maintain traffic between the gateways.

Question from Mr. Schreiber: If the gateways do not benefit from ASC, what are the benefits? Ms. Castelli explained that it would still improve traffic flow throughout the corridor and benefit trips within the corridor. The equipment can also be used to manage traffic during special events. System components are separate, so it's easy to update when new technology is available.

Preliminary Recommendations

Ms. Castelli reported that the team may recommend dropping Alternatives 5 (Road Diet East of School Street) and 13 (Transit Stop Turnouts/Curb Extensions) from the recommendations. She explained that the alternatives can be packaged as short-, mid-, and/or long-term recommendations. This will be discussed further at the next meeting.

Next Steps

Ms. Castelli said one more Working Group meeting will be held (likely in late February) to discuss the final recommendations, costs, funding sources, and permitting, prior to the last public meeting (in Spring 2017). Once the Final Report is released, there will be a 30-day comment period.

Question from Mr. Dushku: Can the next Working Group meeting begin at 6:00 PM? Ms. Castelli said a poll was distributed at the start of the study and the morning timeframe was preferred. The team will see if a 6:00 PM meeting is feasible and will work for other Working Group members.

Mr. Clark encouraged attendees to contact him and Ms. Castelli if they did not have time to ask a question during the meeting. Mr. Clark thanked the Working Group for attending and providing comments, and he concluded the meeting.

ARSENAL STREET
CORRIDOR STUDY

Arsenal Street Corridor Study Working Group Meeting #6: Summary

March 2, 2017, 9:00 AM, Mosesian Center for the Arts, 321 Arsenal Street, Watertown, MA

Purpose

At the sixth and final Working Group meeting, the project team presented the draft study recommendations, costs, funding sources, and permitting that will be included in the Draft Final Report.

Present

Michael Clark, Massachusetts Department of Transportation (MassDOT) Office of Transportation Planning (OTP); Laura Castelli, Caroline Ducas, Michael Gordon, Niki Hastings, and Mike Regan, VHB; Emily Christin and Sarah Paritsky, Regina Villa Associates (RVA); and the following members of the Working Group:

Jonathan Bockian, Watertown Public Transit Task Force (WPTTF)
Sen. William Brownsberger, Massachusetts Senate
Aaron Dushku, Watertown Town Council
Lisa Feltner, Watertown Town Council
Larry Field, Massachusetts Smart Growth Alliance (MSGA)
Tim Goodin, Office of Councilor Mark Ciommo, City of Boston
Philip Groth, Massachusetts Bay Transportation Authority (MBTA) Service Planning
Michael Hailu, MassDOT
Rep. Jon Hecht, Massachusetts House of Representatives
Coriana Hunt Swartz, WPTTF
Emily Izzo, Office of Representative Lawn
Shawn Kelly, athenahealth
Joe Levendusky, WPTTF
Amitai Lipton, MassDOT
Steve Magoon, Town of Watertown
Bridger McGaw, athenahealth
Vincent Piccirilli, Watertown Town Council
Nick Renaud, MassDOT
Gideon Schreiber, Town of Watertown
Matt Shuman, Town of Watertown
Mike Smith, athenahealth

Eliana Lopez, Mosesian Center for the Arts, also attended the meeting.

Meeting Summary

Eliana Lopez, Director of Development for the Mosesian Center for the Arts, welcomed attendees to the newly named "Mosesian Center for the Arts" (formerly Arsenal Center for the Arts).

MassDOT Project Manager Michael Clark provided an overview of the agenda and noted that this is the sixth and last Working Group meeting for the Arsenal Street Corridor Study. He reviewed the study background and purpose along with the four primary goals of the study, to provide some context.

Mr. Clark summarized the study organization and past Working Group meetings. He noted that the previous meeting was held during the Alternatives Analysis phase, and this meeting will focus on the Recommendations. He said the Draft Report is anticipated to be ready for a 30-day public comment period in late April or early May. The final public meeting will be held either just before the comment period or during the comment period.

Mr. Clark led a round of introductions and handed the presentation to Laura Castelli, VHB Project Manager. Ms. Castelli explained how the project team categorized the alternatives as Short Term (0-5 years), Medium Term (5-10 years), and Long Term (over 10 years). She said a lot of factors played into this, such as capital, availability of funding, and existing Town of Watertown projects. The alternatives that are categorized as Short Term require minimal capital and the design is streamlined. The Medium- and Long Term alternatives require environmental permitting and design review.

Ms. Castelli explained that the cost estimates of the alternatives only account for construction costs and do not include further steps such as survey. As each alternative is further developed, the cost will likely rise and a more detailed cost estimate can be developed.

Short Term Recommendations

Alternative 1: Bike Lanes East of School Street

Ms. Castelli reviewed this alternative and recommended that the bike lanes pick up at the limits of athenahealth, continue through Department of Conservation and Recreation (DCR) property, and end at Greenough Blvd. She noted there are existing constraints which were reviewed at the previous meeting, which require the design to be more of a bike shoulder than a bike lane in the northern section. The corridor widens as you move eastward providing more opportunity for 5-foot bike lanes. She said it may be possible to take from the median and the project team would recommend looking for opportunities for a 5-foot bike lane wherever possible.

Ms. Castelli reviewed the construction costs which would vary depending on whether the road receives cold planing (milling and removal/replacement of the top layer of pavement) before restriping. (The construction costs and other details of each alternative can be found on the presentation on the study website, www.mass.gov/massdot/arsenalstreet.)

Ms. Castelli reviewed the action items to help advance this alternative, which include some for the Town of Watertown and some for the MBTA. She noted this is not a complete list, but rather early action items to help the alternative move forward. She also suggested coordinating the project limits and potential construction schedule with the planned improvements being constructed by athenahealth.

Alternative 11: Transit Signal Priority (TSP)

Ms. Castelli summarized this alternative, explaining that TSP enables traffic signals to hold a green light for MBTA buses to get through an intersection. There are ten signalized locations where TSP is recommended along the corridor between North Beacon Street and Arlington Street.

Ms. Castelli explained this would involve relocating some bus stops from a “nearside” location to a “farside” location, which means the stop is relocated after the intersection so it does not interfere with the TSP system when loading passengers. TSP is currently not recommended in either of the Gateway Improvements alternatives, but it should be reevaluated in the future for these locations (Watertown Square and Soldiers Field Road).

Ms. Castelli reviewed the cost estimate, which is $250,000 ($25,000 per location) plus $40,000 per location if a new signal cabinet is required. The team will coordinate evaluating the signal cabinets with the Town of Watertown.

Question from Steve Magoon, Town of Watertown: Does the cost estimate include equipment for the MBTA buses? Philip Groth, MBTA, said MBTA buses are already equipped for TSP.

Ms. Castelli listed the recommended action items for the Town and the MBTA, including evaluating which signal cabinets require upgrades. She added that upon implementation of TSP, there will need to be allowance for maintenance of the equipment.

Alternative 14: Transit Shelters

Ms. Castelli reviewed the locations where transit shelters are recommended. The locations were selected based on their ability to be built alongside an ADA-accessible path. The Town of Watertown may need to get easements from property owners for constructing shelters at certain locations. She noted that the opposite School Street (eastbound) location would only work if it is relocated with Alternative 11: TSP. The cost for shelters is approximately $30,000 per location (excluding property easements, utility relocations, and other considerations).

Ms. Castelli reviewed the action items for the Town of Watertown and MBTA: determining who will be responsible for maintenance and installation, as well as reaching out to property owners and acquiring easements.

Alternative 15: Transit Service Improvements to Existing Routes

Caroline Ducas, VHB, noted that at the previous meeting the Working Group discussed how this alternative is constrained in the short term by the existing MBTA peak vehicle requirements. This alternative would improve off-peak service frequency, and would include schedule adjustments to provide more even headways. She reviewed the estimated incremental operating cost ($200,000 per year, above and beyond the existing Route 70/70A operating cost) and noted that the final cost is dependent upon the MBTA's final service schedule and operating decisions made through the MBTA service planning process.

Ms. Ducas noted the action items for the MBTA to undertake while further analyzing and refining the schedule as part of the bus service planning process.

Alternative 17: Adaptive Signal Control (ASC)

Niki Hastings, VHB, said there are ten locations east of Watertown Square that are recommended for ASC (excluding the Square). She said the cost estimate is $250,000 to $500,000 (depending on the type of communication and server selected), and an additional $40,000 per signal cabinet assembly. Ms. Hastings reviewed the action items, including continuing to evaluate if Watertown Square is suitable for ASC in the future.

Question from Sen. William Brownsberger, Massachusetts Senate: What is ASC? Ms. Hastings explained that ASC would involve installing a sensor in signal cabinets to respond to real time traffic demands and fluctuations, which is more advanced than a preset program, and it would improve traffic flow through the corridor.

Question from Aaron Dushku, Watertown Town Council: Is there a person watching the ASC signals and adjusting them or are they automatic? Ms. Hastings said they automatically detect the real-time traffic information and make self-adjustments. Occasional maintenance is needed.

Question: Are the ASC signals equipped with motion detective loops in the roadway or video camera equipment? Ms. Hastings said video detection is used.

Question: Is this a new technology? Has it been implemented in other towns in Massachusetts? Mike Regan, VHB, said several corridors in the state already have ASC, and the technology has taken a big jump in the last 4-5 years. He confirmed that it is a very successful system if implemented correctly.

Question from Lisa Feltner, Watertown Town Council: Are you recommending ASC for Watertown Square? Ms. Hastings said no, but the project team recommends that the Town evaluate Watertown Square further to determine if it is a good location.

Medium Term Recommendations

Alternative 3: Cross Connectivity between the Greenway and Charles River

Ms. Hastings showed a map of various cross connections from Arsenal Street to the Charles River. She noted that the yellow paths are being progressed by other organizations like athenahealth and the Town, and potentially Boylston Properties. She said there is a potential for a shared use path behind the Hanover property as well. The orange paths are recommended for the Town to consider Complete Streets elements, such as shared-lane markings.

Comment from Gideon Schreiber, Town of Watertown: Arsenal Court is incorrectly labeled on the map and the street that is labeled has no name (Arsenal Court is the next street over). Ms. Hastings thanked him for his comment and said she will correct the map accordingly.

Ms. Hastings said the project team recommends that the Town should continue to support independent paths and reach out to the community regarding the Complete Streets elements. The recommended action items include the Town hosting community meetings to gauge support for this alternative.

Comment from Ms. Feltner: I am concerned there are no connections from Arsenal to Western Avenue, nor any connections to adjacent neighborhoods and towns, including Waltham and Cambridge. Ms. Hastings said the project team understands there are opportunities for connections to other communities, but it is not part of the scope of this study. Ms. Hastings added that the Town is continuing to plan bike connections west on Arsenal Street, along Taylor Street, across Mount Auburn Street and to Saltonstall Park; and an extension of the Watertown Greenway to Alewife. These independent connections will be acknowledged in the Draft Report.

Question from Aaron Dushku, Watertown Town Council: Is there a multiuse path behind the Hanover property? Mr. Schreiber said yes and it is all approved, and there is already a bike and pedestrian connection behind Hanover but it is not open yet as it is under construction.

Question from Larry Field, MSGA: Why is this alternative categorized as Medium Term? Ms. Hastings said it is Medium Term because there has not been any community outreach yet. Mr. Magoon said some elements should be able to start before seven years from now.

Alternative 7: Watertown Square Gateway Improvements

Ms. Hastings reviewed the improvements of this alternative and noted that they were discussed at the previous meeting. Some of the improvements include relocating Charles River Road eastward towards Riverside Street, signal improvements, lane assignment and lane usage improvements, and adding two left turn lanes from Arsenal Street over the bridge. The Route 70/70A bus stop would be relocated closer to Watertown Square.

Ms. Hastings reviewed the recommendations which include evaluating traffic circulation pertaining to Charles River Road and how it will impact neighborhoods.

Comment from Mr. Dushku: The neighborhood there is not thrilled with this alternative, as increased traffic trying to make a left turn from Irving Street to North Beacon Street may cause a backup. Also, is there an opportunity to allow two-way traffic on Riverside Street; perhaps there is a way traffic can turn right. Ms. Hastings said that neighborhood traffic circulation and potential traffic increases and options for Riverside Street would be evaluated from this concept level design if the alternative is progressed.

Question from Joe Levendusky, WPTTF: If Charles River Road is diverted what happens to the bicyclists? Ms. Hastings said they would continue to the bike connection through a shared-use path in the park, with design details determined in a later step. Mr. Levendusky said this option is not helpful without a signalized crossing at the bridge, because no one bikes on Galen Street. He added that what bicyclists do in reality is often not what the planners recommended. Ms. Hastings said the project team will recommend that this be further evaluated.

Ms. Hastings reviewed the lane usage details of the alternative.

Comment from Ms. Feltner: It seems there was no thought given to bicyclists beyond the riverside. Ms. Hastings said incorporating bike lanes here is very challenging given the limited right-of-way. Formal bicycle accommodations were considered and incorporated where right-of-way was available, primarily in the eastbound direction. The team did decide not to consider a reduction in vehicle capacity thought the square as a means of creating space for bicycles, given the limited number of river crossings available to motorists and the effects additional congestion can have on adjacent neighborhoods.

Question/Comment from Mr. Levendusky: The Riverside Google Group is concerned with this plan, so you will need to allow for community involvement. Does this alternative include improvements to signage? Ms. Hastings said there would be improvements to signage in the Draft Report, particularly to alert drivers about lane usage. Mr. Magoon said the Town is working independently to improve signage in the short term.

Question from Vincent Piccirilli, Watertown Town Council: Are there four traffic phases in this alternative? Ms. Hastings said yes, the phases would be reduced from five to four.

Question from Mr. Groth: What happens to the Route 70/70A buses? Ms. Hastings said the Church Street stop would be relocated closer to Watertown Square. This relocation would not require buses to loop. Mr. Schreiber said drivers may end up blocking the bus stop where it is located currently if it is not moved.

Question from Amitai Lipton, MassDOT: Was a Roadway Safety Audit (RSA) conducted? Ms. Hastings said an RSA was conducted at the intersection on the other side of the river, and the project team will coordinate those findings with this alternative. Some of the findings included sign recommendations which could be implemented in the short term.

Question/Comment from Mr. Levendusky: Are the slices of park land where the Founders Monument is located owned by the Town? Mr. Magoon said no, that area is owned by DCR and the Founders Monument is nowhere near here. Mr. Levendusky said this needs to be looked at in terms of Watertown Square, because there seems to be conflicting goals and underutilized green spaces. Ms. Hastings noted that as the concept plan is developed landscaping opportunities will be reviewed and additional public outreach conducted. Mr. Clark added that design and placemaking would be a future step after the planning process. He said the project team is not pushing it aside. Mr. Levendusky said he thinks another study should be done to examine Watertown Square.

Question from Jonathan Bockian, WPTTF: What are the funding sources for these alternatives? Ms. Hastings said that funding sources are being touched upon as each alternative is presented. She clarified there are no funds allocated for any alternatives at the moment.

Ms. Hastings presented the cost estimate for the alternative, and noted that it is only for construction and will increase with other system upgrades and design elements.

Question from Sen. Brownsberger: Why is the Office of Energy and Environmental Affairs (EEA) involved? Ms. Hastings said that is indicative of DCR's involvement, and perhaps an Environmental Impact Report (EIR) would be required because of impacts to DCR property.

Ms. Hastings reviewed the action items recommended for the Town to advance the alternative.

Alternative 10: Express Bus along North Beacon Street

Ms. Hastings said this alternative was discussed at the previous meetings, and said the bus would start at Watertown Square and run along North Beacon Street to the future Boston Landing Station. She explained that that this alternative is recommended to begin as a pilot program from Watertown Square to Boston Landing (which is opening in May). She reviewed potential funding sources and action items, and noted that the cost would vary depending on the type of service.

Question from Mr. Dushku: When did this change from a Bus Rapid Transit (BRT) to an express bus? Can't North Beacon Street fit dedicated lanes? Ms. Hastings explained that the length of the route is not long enough for there to be an obvious market benefit for a BRT. Mr. Clark added that there are certain elements associated with a BRT service (such as off-board fare collection) that the MBTA cannot accommodate at this time, and the project team would like to honestly depict potential service. Ms. Hastings clarified that the service would stop in Watertown Square and Boston Landing, with intermittent stops being worked out by the Town and the MBTA.

Question from Mr. Bockian: Does the MBTA have a policy for the length of pilot programs? Mr. Groth summarized the MBTA's pilot program policy, which he said is evolving but may limit the length to less than one year.

There was a discussion about where stops could be located and the involvement of the Transportation Management Association (TMA). Ms. Feltner said this service could provide options for residents and not just employees. Mr. Magoon said the Town is coordinating with the TMA.

Question from Sen. Brownsberger: Has there been a study on what the demand for this service would be? Ms. Hastings said yes, the project team analyzed journey-to-work census data from 2006 to 2010, as well as the estimated percentage of Watertown commuters who travel to South Station, and established that there is a constituency that would use this service. Sen. Brownsberger asked about the anticipated volume of ridership. Ms. Hastings said there is anticipated to be enough for at least one shuttle bus (approximately 30-40 people) during peak hours, and it is important to keep in mind that trains at Boston Landing will run on a limited schedule which this bus would have to connect to for transferring riders. Mr. Schreiber added that there are way more people traveling to the Seaport now than when the 2006-2010 data was collected. Mr. Groth added that the MBTA has new data available to study commuter movements through CharlieCard taps, which may also help predict potential volume. Ms. Hastings confirmed that a potential future West Station connection was looked at, as well as Packard's Corner.

Comment from Mr. Dushku: The previous meeting had information on estimated times for this service, which would be helpful to add in the Draft Report. Ms. Hastings confirmed the times will be in the Report.

Comment from Rep. Jon Hecht, Massachusetts House of Representatives: It would be helpful to have explicit statements of benefits for each alternative in quantifiable terms, especially for the public meeting.

Alternative 15: Transit Service Improvements to Existing Routes

Caroline Ducas, VHB, explained that the short-term recommendations for this alternative were limited based on the existing fleet size. For the medium term, the project team looked at opportunities to improve service with an expanded fleet, which would help to alleviate crowding. She noted one of the key hindrances of reliability today is the long length of the Route 70/70A bus routes. This alternative recommends splitting Routes 70/70A into the existing Route 70, a loop circulator that would operate between Waltham Center and North Waltham, and a trunk route that would operate between Waltham Center and Central Square. In addition, the project team would recommend as part of this alternative: implementing an express service along the trunk route scheduled to allow for coordinated transfers, increasing peak and off-peak service frequency, and adjusting the schedule for targeted trips to provide more consistent headways.

Ms. Ducas reviewed the capital cost estimate, which includes $900,000 per bus with an estimated four additional buses required. She explained that the peak vehicle requirement is a system-wide issue, and there may be opportunities to reallocate some buses to Routes 70/70A. An increase in facility capacity would be required in order to accommodate an increase in the MBTA's system-wide fleet. She noted that the capital cost estimate of $3.6 million is for the vehicles alone, and does not include the costs required to expand storage facility capacity. Ms. Ducas added that the capital cost estimate does not account for the possibility of articulated buses, which would have a higher cost per bus. She reviewed the estimated incremental operating cost ($800,000 per year, above and beyond the existing Route

70/70A operating cost) and noted that the final cost is dependent upon the MBTA's final service schedule and operating decisions made through the MBTA service planning process.

She reviewed the action items for this alternative, including a further look at system-wide vehicle scheduling and potential tweaks to routing as part of the MBTA's service planning process. The public involvement for the more substantial medium term alternative recommendations would also be more extensive than for the short-term alternative.

Question: How long is the life expectancy of these buses? Mr. Groth said approximately 12 years.

Question from Mr. Magoon: Is the addition of the four buses to accommodate the route splitting or for adding capacity? Ms. Ducas said it is for the entire package. The recommended package would meet demand by using two additional buses for route splitting and two additional buses for increased service frequency, including express service.

Comment from Mr. Lipton: The Route 128 Business Council might be able to privately operate part of the loop.

Question from Rep. Hecht: Do you have estimates of the time savings from the express service? Ms. Ducas said the project team estimated up to 9-10 minutes of time savings from Waltham Center to Central Square, but that depends on the future policies of the MBTA. She noted that with Automated Fare Collection (AFC) 2.0, the MBTA would accept new fare media types and allow for all-door boarding, which would result in additional time savings. She said these time estimates assume the local bus stops at every stop along the route (which often they do not).

Question: Does the 9-10 minute estimate account for TSP? Ms. Ducas said that it does not. A discussion followed regarding how the MBTA is trying to improve service for inbound passengers on Route 70/70A, and is updating its Service Delivery Policy. Ms. Ducas confirmed that the service improvements would meet projected user demand.

Question: How many buses are currently serving Route 70/70A? Mr. Groth estimated about 13 to 15.

Question from Mr. Bockian: Does the plan to privatize maintenance facilities open up the possibility of additional maintenance capacity? Mr. Groth said he is not the best person to answer that question, but he believes so.

Question from Mr. Levendusky: How does the length of Route 70/70A compare to other routes? Mr. Groth said it is one of the longest routes in the MBTA system.

Question from Mr. Schreiber: There is a lot of demand to use the Route 70/70A bus currently, but does the model account for potential future ridership who are not riding it now? Ms. Ducas said the model accounts for projected growth, and noted that the new route would also affect transfers north of Waltham.

Question from Mr. Levendusky: Has there been any discussion about possibly having a starter on the route to allow for real time management of the bus? Mr. Groth said that he agrees that starters are often helpful, but the length of Route 70/70A is a greater factor in its reliability. The MBTA does not have enough manpower to add starters to as many routes as they would like.

Long Term Recommendations

Alternative 6: Soldiers Field Road Gateway Improvements

Ms. Hastings summarized the improvements with this alternative, including intersection improvements with signal timing and re-striping and relocating a portion of Coolidge Avenue. There are two alternatives for relocating Coolidge Avenue:

- Alternative 1: Signal phasing remains the same but right-of-way (ROW) confusion is resolved; a new 40-foot wide road connects Arlington Street to Coolidge Avenue and accommodates all modes; Coolidge Avenue would be closed at Arsenal and Arlington Streets and Coolidge Avenue traffic would shift to Arlington Street. There are potential wetlands impacts so environmental permitting would be required, as well as property impacts.
- Alternative 2: Similar to Alternative 1, Coolidge Avenue would be closed at Arsenal and Arlington Streets; a new road connects Coolidge Avenue to Arsenal Street, providing better access for UPS but impacting private property. This would remove some traffic from the signal and would likely result in operational improvements.

Ms. Hastings explained that both alternatives are long term because of the extensive permitting that would be required. She reviewed the construction costs and action items for the alternatives, including further research on permitting needs. Ms. Hastings reviewed the implementation timeline for each alternative.

Comment from Mr. Field: The implementation slide in the presentation is much clearer than the handout. I recommend using the slide for the public meeting.

Comment from Ms. Feltner: Ms. Feltner said there needs to be more short term benefits for residents to get excited about, and aesthetics of what Arsenal Street will look like should be discussed. Ms. Hastings said that design of aesthetics is not part of the study, but the Draft Report will include discussion of improving the public realm.

Comment from Mr. Levendusky: I agree with Ms. Feltner. It is important to incentivize community support early on to get people onboard.

Comment from Mr. Magoon: The study can categorize Alternative 3 as Short Term.

Comment from Mr. Lipton: A lot of work in Alternative 7 can be completed in the Short Term. For Alternative 6, did you look at Elm Street as a way to divert traffic from Arlington Street? Ms. Hastings said no because it is too narrow.

Question from Emily Izzo, Office of Representative Lawn: I take the Route 70 bus every day, and I often see two buses come at one time. Will these improvements help space the buses out more evenly? Mr. Groth acknowledged the issue, and said outbound buses are easier to coordinate than inbound. Mr. Lipton added that TSP will help that issue as well.

There was a discussion about signal upgrades the Town is negotiating with athenahealth. Mr. Magoon confirmed that the consultants on the various projects are coordinating and sharing information.

Next Steps

Mr. Clark reviewed the study schedule, and noted that the last Working Group and public meetings have been switched on the presentation slide. The final public meeting will be held in late April or early May.

Comment from Rep. Hecht: It would be better to schedule the public meeting after the Draft Report is released, rather than before, so the public has an opportunity to review it and provide more feedback.

Mr. Clark thanked the Working Group for attending and providing comments, and he concluded the meeting.

ARSENAL STREET
CORRIDOR STUDY

Arsenal Street Corridor Study - Public Meeting #3: Summary

June 22, 2017, 6:00 – 8:00 PM, Watertown Free Public Library, 123 Main Street, Watertown, MA

Attendees

Michael Clark, Massachusetts Department of Transportation (MassDOT) Office of Transportation Planning (OTP); Laura Castelli, Caroline Ducas, Michael Gordon, Niki Hastings, Albert Ng, VHB; Nancy Farrell and Sarah Paritsky, Regina Villa Associates (RVA); elected officials; and members of the public (see attendance).

Meeting Purpose

The purpose of this third and final public meeting on the Arsenal Street Corridor Study was to present the recommendations outlined in the Draft Final Report and gather public feedback. The presentation from the meeting is posted on the study website at: www.mass.gov/massdot/arsenalstreet

Meeting Summary

Introductions

Nancy Farrell, RVA, opened the meeting, welcomed attendees, and reviewed the meeting guidelines. Michael Clark, MassDOT Project Manager, reviewed the meeting agenda and provided an overview of the study background and purpose. He said this is the last of three public meetings on the project and six Working Group meetings were held.

Study Background

Mr. Clark provided an overview of the study process, which involved five key steps: framework, issues evaluation, alternatives development, alternatives analysis, and recommendations. He said the release of the Draft Final Report initiated a 30-day comment period. The team will be accepting public comments on the Draft Final Report and recommendations through July 5. He encouraged attendees to complete the comment form that was distributed at the meeting and said he is also accepting emails and letters. Mr. Clark said the comments will be included in the Final Report.

Mr. Clark explained that the Working Group is composed of municipal officials, elected officials, and community representatives. Between 25 and 40 members attended each meeting and provided feedback on the recommendations as they were developed.

Laura Castelli, VHB, introduced herself and explained the meeting's goal to present fairly detailed information about the recommendations. She and her staff will be available to discuss the details one-on-one with attendees following the presentation during the open house. She said she will present the alternatives methodology, provide an overview of each recommendation and its benefits to the community, and first steps for the Town of Watertown for implementation.

Alternative Analysis Methodology[1]

Ms. Castelli explained that the recommendations were categorized into three buckets based on the amount of permitting that will likely be required, anticipated costs, and level of design: short term (0 to 5 years), medium term (5 to 10 years), and long term (over 10 years). She said the anticipated timeframes will depend on the Town's priorities, environmental permitting, and funding availability. Ms. Castelli said the construction cost estimates should be used for planning purposes and were developed based on available information. Costs do not include survey, design, right-of-way (ROW) acquisition, and permitting. She said more detailed cost estimates would be developed should projects advance.

Recommendations

Ms. Castelli noted that two alternatives shared at the October 2016 public meeting are no longer being considered. The analysis and findings that led to their dismissal are part of the Draft Final Report and will be part of the open house discussion if community members are interested.

Short Term: 1 – Bicycle Lanes East of School Street

Niki Hastings, VHB, described the recommendation to extend bicycle lanes from Talcott Avenue to Greenough Boulevard in the eastbound and westbound directions. She reviewed the conceptual layout and said travel lanes would be narrowed to 11' to accommodate the bike lanes, which would be 4.3' to 5' depending on available ROW space. This recommendation supports active transportation initiatives and would close a big gap in the bicycle network. The project could be accomplished without impacts to private property or environmental permitting. The next steps to implement this proposal would be for the Town to progress to final design and seek funding.

Short Term: 3 – Cross Connectivity between the Greenway and Charles River

This recommendation involves creating connections between neighborhoods adjacent to Arsenal Street and the River, via pathways that are being progressed by nearby developments (many of which are concentrated in the eastern portion of the corridor) or local streets. This recommendation is for the Town to consider adding complete streets elements (which may range from shared lane markings to the possibility of one-way roadway pairs) on Irving Street, Beechwood Avenue, Louise/Paul Street, and near the Arsenal Mall. Making these connections would have benefits similar to the first recommendation. To progress this project, the Town could organize community outreach and discussions with neighbors.

Short Term: 11 – Transit Signal Priority (TSP)

Ms. Castelli said the team recommends TSP at eight locations along the corridor. TSP is a technology that reduces dwell time at traffic signals for transit vehicles by holding green lights longer when a bus is approaching. The communication helps reduce bus travel time along the corridor at key intersections, can assist with progression for vehicles, and may help relieve cut-through traffic on local streets. The next steps for this recommendation would be for the Town to consult with the Massachusetts Bay Transportation Authority (MBTA) and install software in the traffic signal controller that would be compatible with TSP equipment on buses. There would be cost-benefit increases if TSP is combined with other improvements. Some bus stops that are just before the signal would need to be relocated to the far side of the intersection for TSP to work efficiently; otherwise, the signal would hold a green while buses are loading and impact side street operations.

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[1] Note: The project team understands that the I-Cubed funding (passed by Town Council one week after this public meeting) may dramatically change funding and schedule opportunities for the town. While the project could not assume this funding in place for the purposes of the Final Report, the recommendations contained herein can be accomplished on the accelerated schedule needs of the I-Cubed grant. Next steps for the Town may differ accordingly.

Short Term: 14 – Transit Shelters

Ms. Castelli said the team looked at all bus stops in the corridor and recommends shelters in four locations to help improve bus riders' experience, particularly on a bad-weather day. She said the four locations each have slight property impacts, so the Town would need to work with property owners to secure easements. The bus stop across from School Street (adjacent to 311 Arsenal where the cannons are located) could only be installed if the stop were to move to the other side of the intersection.

Short Term: 17 – Adaptive Signal Control

Ms. Castelli described the recommendation for Adaptive Signal Control at 10 locations, eight of which are the same locations where TSP is recommended. Adaptive Signal Control technology is a traffic management strategy in which traffic signal timing changes, or adapts, based on actual traffic demand. It helps control signal coordination while factoring in pedestrians and bicycles. It can help alleviate congestion and reduce cut-through traffic on local streets and it would provide a coordinated "green band" to improve mobility along the corridor. To implement this recommendation, the Town would need to develop an implementation strategy and select the appropriate equipment.

Short Term: 15 – Transit Service Improvements to Existing Routes

Caroline Ducas, VHB, said this recommendation involves using the MBTA's existing resources to improve bus routes 70 and 70A. She referred to the existing and future conditions chapters of the Draft Final Report that summarize crowding during peak and off-peak periods that is projected to increase over time as ridership grows. She said improvements to the routes could help reduce overcrowding. Due to fleet constraints during the peak period, increased service frequency during off-peak hours could be explored. In the short term, the Town can work with MBTA Service Planning on quarterly schedule updates.

Medium Term: 15 – Transit Service Improvements to Existing Routes

Ms. Ducas described a medium-term package of recommendations to improve transit in the corridor, including splitting the 70/70A into three routes: (1) the existing route between Central Square in Cambridge and Marketplace Drive/Cedarwood in Waltham; (2) a proposed loop circulator between Waltham Center and North Waltham; and (3) a trunk route that would operate between Waltham Center and Central Square. She said the changes would allow for targeted service increases and improved reliability, as the very long length of the routes is a major reason for current delays. She noted that the splitting of routes would create a very large bus-to-bus transfer location at Waltham Center. She described potential measures that could be explored by the MBTA to mitigate the Waltham Center transfer for riders on the proposed loop circulator route, including the creation of timed transfers at Waltham Center with express service to Cambridge, or improved loop circulator route service (such as an increased span of service). Ms. Ducas described operational constraints of express service (bus bunching, passenger confusion regarding which bus to board) and said an alternative to express service would be the consolidation of bus stops along the route to help reduce travel times. In addition, schedule and service frequency adjustments could help to accommodate the more than 20% expected increase in ridership by 2040. The medium-term package of improvements would require the use of four additional buses. To move these recommendations forward, the Town would need to discuss them further with the MBTA.

Medium Term: 10 – North Beacon Street Express Bus

Ms. Castelli explained that a new express bus service could connect Watertown Square with the new Boston Landing commuter rail station in Brighton. The bus would be timed to align with the commuter rail schedule to facilitate transfers to that service, possibly with one interim stop at a location (along North Beacon Street in Watertown) to be determined. She said this recommendation helps address job growth in and the lack of transit options to the South Boston Waterfront. She said it could also help alleviate congestion on Route 70/70A and potentially other MBTA express bus routes. The team recommends the Town coordinate with the MBTA on a pilot service. Ultimately, the express bus could be sponsored by the planned Watertown Transportation Management Association (TMA) or a public-private partnership.

Medium Term: 7 – Watertown Square Gateway Improvements

Ms. Castelli explained that this recommendation doesn't fully fix Watertown Square, but tries to address issues with lane changes that are causing safety deficiencies. The recommendation restripes lanes at the intersection to better facilitate the desire lines of vehicular traffic and reduce congestion. She described lane marking changes at each leg of the intersection, as well as modified signal phasing. One key change would be a discontinuance of westbound Charles River Road, which would require the houses in an adjacent neighborhood (primarily those located between Wheeler Lane and Irving Street south of Riverside Street) to use Irving Street instead to access Watertown Square. The alternative would eliminate westbound cut-through traffic that currently uses Charles River Road to avoid congestion on North Beacon Street and Arsenal Street. Eastbound access to Charles River Road from the Square would still be provided via Riverside Street, with a connection back to Charles River Road. The existing Charles River Road would remain two-way between North Beacon Street and Wheeler Lane for local access. These improvements would shorten pedestrian crossings, improve bicycle mobility, and improve wayfinding for vehicles. The bus stop in front of the fire station would be relocated to allow riders to see when the bus is coming and reintroduce transit to Watertown Square proper. Ms. Castelli said that to move this forward, the Town would need to begin public outreach (including to potentially affected residents and businesses) specific to this project and begin permitting.

Long Term: 6 – Soldier's Field Road Gateway Improvements

Ms. Castelli said this improvement would require closing Coolidge Avenue to through-traffic to help with sight distances and safety for all modes. Access to Coolidge Avenue would change, thereby improving traffic flow at the intersection. Ms. Castelli said this is a very long-term recommendation because it would require substantial environmental permitting. To move forward with this project, the Town would need to start outreach to businesses, gather public input, and work with the Department of Conservation and Recreation (DCR) about permitting.

Key Takeaways

Ms. Castelli shared some key takeaways from the presentation:

- Recommendations complement each other but can be implemented individually, depending on available funding.

- Improvements to transit services can improve service reliability and potentially encourage mode shift, representing the greatest opportunity of all recommendations to alleviate “cut through” traffic adjacent to the corridor.
- The town, and its residents, will need to “champion” and lead recommendations with state agency involvement.
- Recommendations at Watertown Square and Arlington Street have the most potential for landscape/ streetscape elements that can change the defining character of the corridor.

Ms. Castelli described the implementation plan and referred to the recommendations handout.

Next Steps

Ms. Castelli said the 30-day comment period on the Draft Final Report will close on July 5. Next, the project team will review comments and incorporate them into the Final Report. She encouraged attendees to provide comments, both written and verbal, to her or Mr. Clark.

Questions & Answers

An attendee asked about maintaining space on the road for vehicles and bicycles when snow is plowed. Ms. Castelli said the team did consider maintenance when proposing bicycle lanes. The City of Cambridge makes property owners responsible for snow removal, which is an option for Watertown. When snow is plowed to the curb, the space for bike lanes is also cleared, but realistically, there may be winters where bike lanes cannot be in service due to snow storage requirements. In that case, the bike lane could provide extra storage area, even though that is not the intent.

Ms. Farrell opened the floor to questions from elected officials and noted that a summary of this meeting will be posted to the project website.

Representative Jon Hecht thanked the audience for attending and said the great turnout is an indication of the strong interest in this project and the importance to the Town. He thanked MassDOT for investing state resources and responding to the community’s request for the study. Rep. Hecht said he thinks the recommendations balance vehicular, pedestrian, and transit improvements. He said the community is responsible for making sure the recommendations are implemented and referenced the Town’s transportation demand management work and TMA development. He said the Town is working with developers. He also referenced the state’s recent funding of a bike path through Fresh Pond, to Arsenal Street and the Charles River.

Joe Levendusky, Watertown Public Transit Task Force (WPTTF), said a 4.3’ bike lane is not very wide and would likely not be fully plowed during snowstorms. He asked if the curbs could be moved to widen the bike lane. Ms. Castelli said the team considered this adjustment, but the sidewalks are currently the minimum width to meet the Americans with Disabilities Act (ADA) requirements. Buildings along the corridor are right up against the sidewalk. If a 5’ bike lane were to be designed, there would be significant impacts to buildings. She referred to the presentation from Working Group #5, available on the study website. Ms. Castelli explained that closer to the Arsenal Mall the right-of-way can accommodate a 4.9’ bike lane.

An attendee said the various projects and public meetings can be confusing. She asked how this study, mitigation funding, and the Infrastructure Investment Incentive Program (I-Cubed) all fit together. She also asked if I-Cubed could fund these recommendations. She also requested a longer question and answer session. Steve Magoon, Watertown Department of Community Development and Planning

(DCDP), said I-Cubed provides an opportunity to fund a lot of projects. Mr. Magoon later explained that I-Cubed is a program that uses tax from development projects combined with state backing to pay for public infrastructure improvements. He said a total of $25 million will be used in this corridor and adjacent areas. Mr. Magoon said the Town is coordinating with various developers and this study's recommendations to create a single project. He noted not all of the study recommendations qualify for I-Cubed funding and also emphasized that I-Cubed will be implemented in a short timeframe. He encouraged everyone to attend a Council hearing on I-Cubed on June 29.

Councilor Lisa Feltner said as transit demand continues to increase, she hopes that the transit improvements will be a given. She said public transit is her priority. Ms. Farrell thanked her for her comments.

Jon Bockian, WPTTF, asked how realistic it would be to implement the Watertown Square improvements in six years. Ms. Castelli said it is not unrealistically long, but will depend on funding. She said the program should be well-positioned for state Transportation Improvement Program (TIP) funds, which would begin in 2022. Mr. Magoon said these improvements were proposed as part of the I-Cubed program, but would be fast-tracked to happen within a 3-year period of public outreach, design, and construction. Mr. Bockian expressed his support to extend the question and answer session. Ms. Farrell polled the room and all agreed to extend the question and answer session and reduce the open house time.

A resident of the western part of Watertown described large amounts of ridership on transit along Pleasant Street heading to Boston. He said the express bus could stop on Pleasant Street to pick up riders there. Ms. Castelli said the stops have not been planned in such detail at this point and encouraged him to speak with Ms. Ducas and Michael Gordon during the open house to learn more.

An attendee asked why bicycle routes are proposed on Arsenal Street when there are bike lanes and paths on North Beacon Street and elsewhere. Ms. Castelli explained that four of the top six employers in Watertown are located on Arsenal Street. While there are a lot of connections to the corridor, there are none along the eastern portion of the corridor. She said the feedback from previous public and Working Group outreach indicated a need for bike access to companies and housing on Arsenal Street. In addition, bicycle lanes are an element of the town's Complete Streets program.

Angie Kounelis, East End Town Councilor, said the good turnout at the meeting shows the community's interest in the study. She requested additional detail on the Arlington Street intersection and realignments of Coolidge Avenue. Ms. Castelli described how the first alternative alleviates some of the permitting issues but does run along a stream with impacts to wetlands and private property. She said it does not remove traffic from the intersection, but moves it to a different approach. The second alternative has greater operational benefits by removing Boston-bound traffic from the intersection. However, the alignment would go through the Mount Auburn Athletic Club parking lot and a property owned by DCR. She described the lengthy environmental permitting required. Councilor Kounelis asked Mr. Magoon about traffic signals on Lower Greenough Boulevard. He said the intersection will be realigned and signalized, and might fit better with Alternative 6's option 2 than option 1. He added that I-Cubed will let the Town coordinate these adjacent projects into one effort and redirect some of the mitigation funds from developers.

An attendee asked what would happen to the existing locations where there are transit shelters. Ms. Castelli said one might be relocated if the bus stop itself is relocated (part of the TSP recommendation), but there are no recommended changes to other existing shelters.

An attendee asked how many cars use Arsenal Street and how much that number will grow after the developments. Ms. Castelli estimated approximately 20,000 cars use the street per day now. She said the regional study area includes adjacent towns, while the local study area focuses on the corridor and adjacent areas. The study team took baseline counts in Fall 2015, worked with the Central Transportation Planning Staff (CTPS) on economic projections, and considered projects in the neighborhood to establish a 20% growth rate. She said the data is in the third Working Group and second Public Meeting presentations on the project website. The attendee asked if Lower Greenough Boulevard would be closed and Ms. Castelli said it will not.

An attendee said she does not own a car and is transit-dependent. She asked about the local and express bus service on North Beacon Street. Ms. Castelli said the team did not look at expanding local service along North Beacon Street because there are no local connections or origin/destination points to support service. For local ridership purposes, it is likely the route would be located too close to Arsenal Street to support independent service. She said there would be an interim express bus stop at a location along North Beacon Street to be determined. The attendee added that there is a group home on Irving Street, so she does not think this is a safe place for a bike path.

An attendee asked how many lanes there will be on Arsenal Street. Ms. Castelli said Arsenal Street would remain two lanes in each direction.

An attendee referred to the new bike lanes near construction on Arsenal Street between Irving Street and School Street. He said the on-street bike lane begins at School Street and disappears near the Auto Zone. He asked if the bike lane could be continued at sidewalk level along the north side of Arsenal Street. Ms. Castelli said the team looked into this option but due to the impacts to buildings, there would be no space to continue a separated bike lane in that location. Gideon Schreiber, Watertown DCDP, said there is a plan for dedicated bicycle accommodations headed towards Watertown Square.

An attendee asked about improvements at Soldiers Field Road. Ms. Castelli said this was originally part of the study but is now part of a City of Boston project. Mr. Clark said the project was recently initiated as mitigation for the 530 Western Avenue development. He said he believes there will be a public meeting this fall on the project.

Mr. Bockian said many community members wished the study happened earlier and is very helpful. He thanked Rep. Hecht for being instrumental in making the study happen.

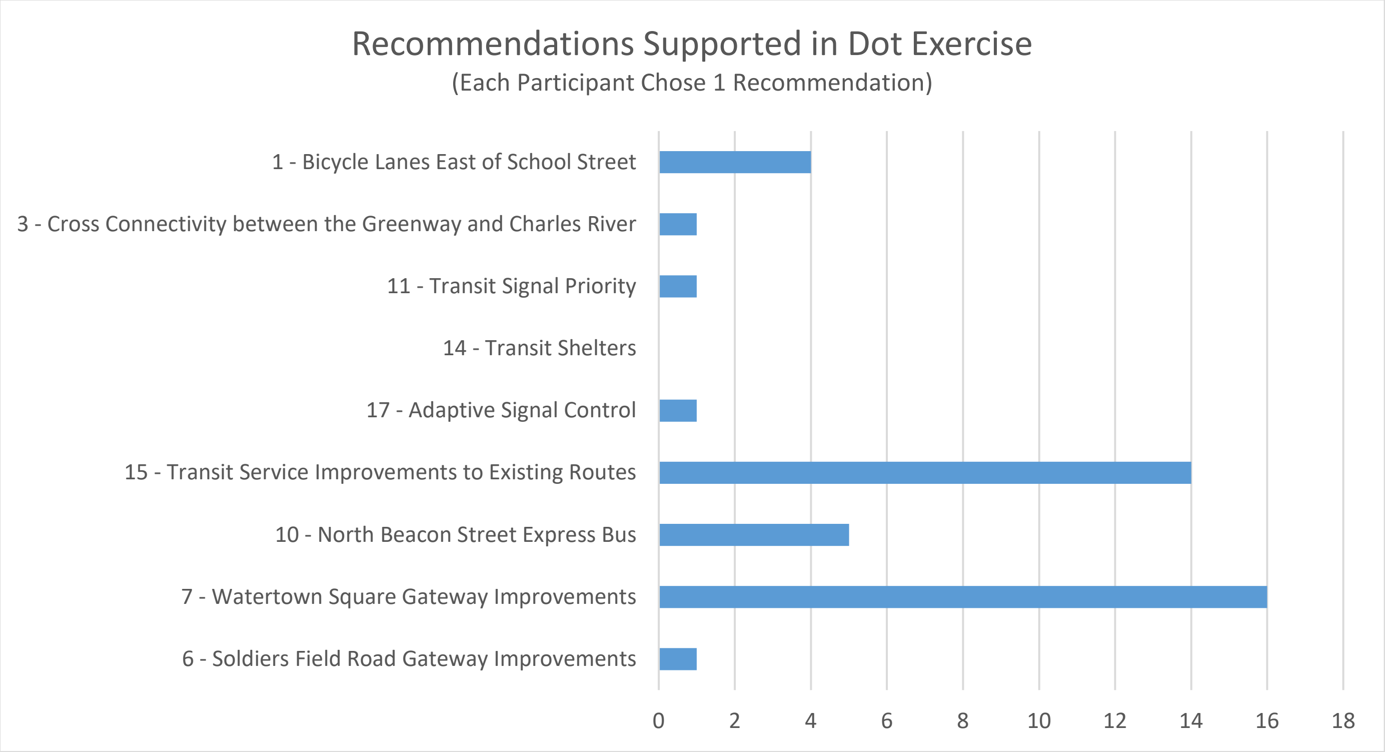
As there were no further questions, Ms. Farrell thanked everyone for attending and asked participants to move to the other side of the room for the open house.

Open House

The study team staffed various tables around the room, described the recommendations and the analysis used to develop them in more details, and answered participants' questions.

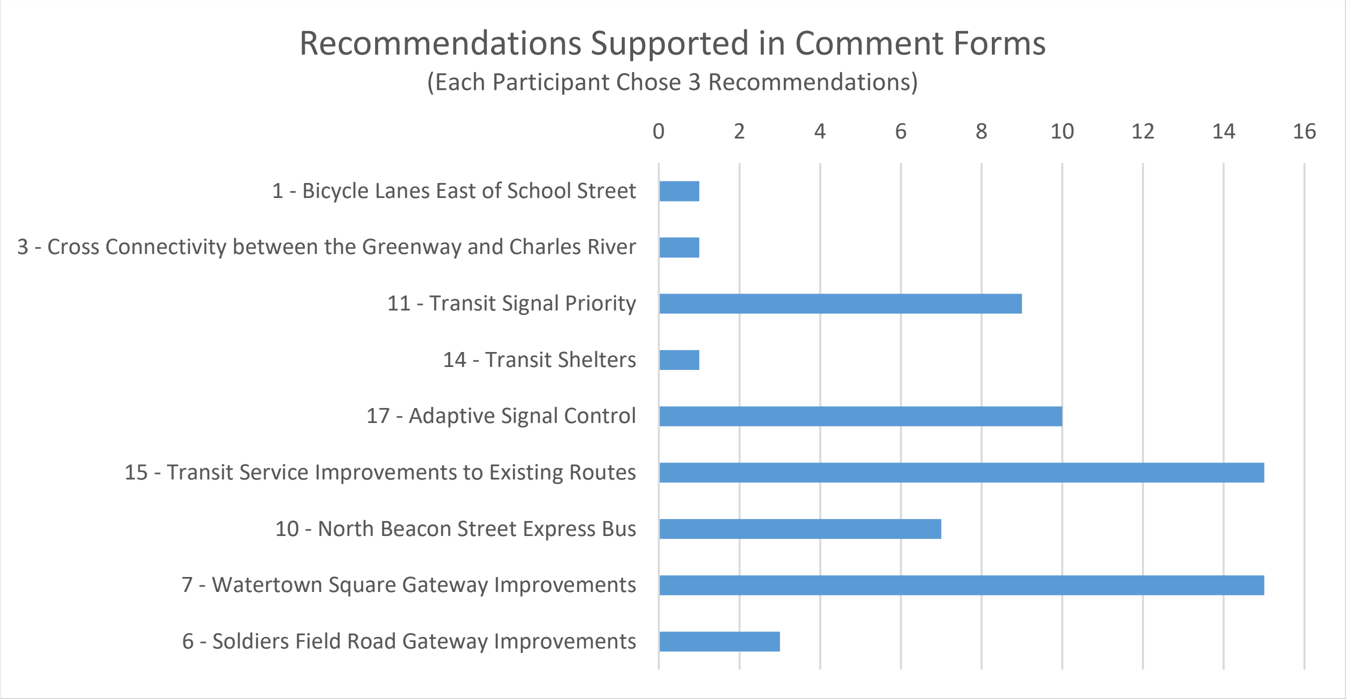
Each participant was offered a dot to place next to the single recommendation he or she felt should be prioritized. A total of 43 attendees participated in the dot exercise, the results of which can be found below:

Table 1 – Dot Exercise Results



A total of 22 attendees completed written comment forms that asked three questions. Question 1 asked the commenter to select up to 3 alternatives they think should be prioritized. The results are below.

Table 2 – Question 1 Results



Transcribed responses to Question 2: Why do you think these alternatives should be prioritized?

- Untangling the limitations that currently make public transit in Watertown ineffective, unreliable, and unappealing to large segments of the population, especially in terms of changing the 70/70A routes to solve the scheduling issues and resulting bus bunching, could significantly shift the mode share distribution and therefore reduce SOV use and therefore traffic problems! (As well as making Watertown more accessible to public transit users of course.)
- 1) Improving existing service. 2)Watertown Square Gateway Improvements. 3) North Beacon St. Express Bus - Express & Local from Watertown Sq. which could connect w/ the 70/70A or 71 buses and have a local bus from the square for the back end of Athena and perhaps the Arsenal Yard Apartments.
- I believe they would be the most effective at promoting walking, biking, and transit as an alternative to driving.
- Make Public Transit more efficient and more attractive to commuters. Make traffic move more safely and sensibly.
- I feel that the existing service pattern of the 70/70A bus route is an impediment to increased transit usage, which could have an outsized impact by reducing the volume of vehicles. Both adaptive signal control signal and improvements to Watertown Sq. could ease the flow of traffic, which is one of my personal pain points.
- Will have big impact on many travelers. Watertown Sq could be a lot better!
- Affect a greater number of people.
- Important for our business, New Repertory Theatre on the Arsenal Campus to have public transportation for our employees, artists and patrons. The potential of bringing a younger audience to Watertown depends on public transportation that runs more frequently and later at night.
- This is where the heaviest congestion occurs.
- 17 + 7 are needed long term and we need to get them started. 15 transit service improvements are key to addressing significant growth and traffic on corridor. Bike lanes and connectors are desirable and hopefully will continue to progress.
- 15, 10, 7, + 17!
- Favoring people moving in transit vehicles is the best way to get those transit riders moved faster and more reliably - to support mode shift and emissions reductions.
- Mass Transit is the best all - weather approach to reducing single occupancy vehicle trips. I am a bicyclist and feel that North Beacon St. is an inherently safer cycling corridor than Arsenal St.
- Making Mass Transit more reliable and frequent and affordable is the best way to get people out of their cars (to get THE MOST people out of cars).
- If the slope isn't changed on Arsenal St. it will continue to cause water damage to numerous homes. Who pays that bill for damage to the home that was & is preventable. WAKE UP PEOPLE.
- Highest impact in short/medium term but long-term benefits
- I support improved transit. Gateway improvement - gateways are where bottle necks happen.
- Realigning Watertown Sq. would be a big help in making traffic move smoothly. Eliminating Charles River Road connection will take getting used to, but would help with the flow. A new bus connecting to Boston Landing would be great for commuters. It would be nice to have it start

further west maybe at Waverly and Main or Pleasant and Myrtle. I like the idea of traffic signals that change with traffic conditions.

- The current lighting system is antiquated and inefficient, creating air quality issues by having cars get stuck at lights that are not sequenced properly. Hopefully, also implementing TSP will also improve traffic flow as well. I am concerned with bike traffic and hope that the WPD would be tasked with enforcing bicyclists following the rules of the road, which I do see frequently ignored. The potential for hazards caused by bikers would need to be managed.

Transcribed responses to Question 3: Would you like to share any other comments with MassDOT regarding the Arsenal Street Corridor Study Draft Final Report?

- I'm praying for implementation. These are a lot of good ideas; I'm hoping we can see more follow-through and less shelving than sometimes happens.
- Have you considered the safety of pedestrians when crossing over main streets, N. Beacon, Greenough Blvd. & Charles River Rd? Could raised, over-street archways for pedestrians be considered? 2) Irving St. should not be considered for a bike path since adults with physical (cerebral palsy) and cognitive disabilities live there and increased traffic in terms of cars and bike paths would be dangerous for these people. 3) Too much [illegible] on bike paths. We should have a bus lane on Arsenal St. and improve the existing bike baths on N. Beacon and Charles River Rd.
- A concern about Watertown Sq. improvements - making traffic flow through Riverside to Charles River Rd. The eastbound (sic) traffic on Charles River Rd. would be channeled up through Irving St. This is the Perkins neighborhood and the Perkins people are already nervous about the Riverside/Irving Intersection. It is very residential and there is a park. People already drive way too fast between Riverside and N Beacon. Also with the new light configuration at N Beacon and Arsenal, the residents of Irving Park neighborhood are having trouble getting through the N Beacon intersection, mostly because of the westbound traffic on N Beacon turning right on Irving. This has gotten much worse since Beacon Park closed access to Arsenal. The Irving Park neighborhood will not want increased traffic on Irving. Those huge apartment complexes on Arsenal are not even finished yet. The traffic will be MUCH worse for us. I am hopeful that the lane reconfigurations for Watertown sq. will be enough and Charles River Rd can be left alone.
- As a long-time resident who commutes to Cambridge, there is little that can be done to improve the 70 service enough for me to consider using it on a regular basis. Overcrowding of buses by the time they reach the square is only one factor. Lack of comfort (temps too cold in summer, so one is forced to bring a jacket) uncomfortable seating is another issue. Add in families with SUVs for strollers and there is even less room for someone to ride. So I'll continue to drive up Arsenal Street, and hope the improvements help more than hinder car traffic over time.

Attendance

Connie Brown
Gordon Brown
William N. Brownsberger, Massachusetts Senate
Bruce Coltin
Andre Compagne, Watertown Bike/Ped Commission
Bill Conroy, Boston Transportation Department
Aaron Dushku, Watertown Town Council
Susan Falkoff, Watertown Town Council

Larry Field, Massachusetts Smart Growth Alliance (MSGA)
Philip Groth, MBTA Service Planning
Nancy Hammett
Jonathan Hecht, Massachusetts House of Representatives
Coriana Hunt Swartz, WPTTF
Janet Jameson
Angie Kounelis, Town Councilor
Joe Levendusky, WPTTF
Anna Mackay, Guerrilla Development
Steven Magoon, Watertown DCDP
Ilana Mainelli
Kathy Martin
Bridger McGaw, athenahealth
Elodia Thomas
Steve Owens
Anthony Palomba, Watertown Town Council
Mark Peterson, WPTTF
Vincent Piccirilli, Watertown Town Council
Rachael Sack
Maria Saiz, Watertown Bike/Ped Commission
Melissa Santucci Rozzi, Watertown Zoning Board of Appeals
Gideon Schreiber, Watertown DCDP
Adam Sennott, Watertown Tab
Matt Shuman, Town of Watertown, Department of Public Works
Pat Sullivan, 128 Business Council

ARSENAL STREET
CORRIDOR STUDY

Comments Received on Draft Final Report

Log of Comments

Original Comments and Responses

Comments Received on Draft Final Report - Arsenal Street Corridor Study

ID No.	Date Received	Name	Affiliation (if any)	Source	Primary Topic/Theme (vehicles/traffic, bike, ped, bus, etc.)	Response/Action
2017-06-10_1	6/10/2017	Larry Stabile		Email to Michael Clark	bike	M. Clark sent response
2017-06-23_1	6/23/2017	WM		Email to Michael Clark	bike	M. Clark sent response
2017-06-25_1	6/25/2017	Teddy Kokoros		Email to Michael Clark	bike, transit	M. Clark sent response
2017-06-29_1	6/29/2017	Marcia Ciro	Watertown resident	Email to Michael Clark	vehicles, traffic	M. Clark sent response
2017-07-09_1	7/9/2017	Jonathan Bockian		Email to Michael Clark	bus, traffic, other	M. Clark sent response
2017-07-08_1	7/8/2017	Gordon Brown		Email to Michael Clark	trafffic	M. Clark sent response
2017-07-10_1	7/10/2017	Betty and Alan Gordon		Email to Michael Clark	traffic	M. Clark sent response
2017-07-04_1	7/4/2017	Mary McGreal		Email to Michael Clark	safety	M. Clark sent response
2017-07-05_1	7/5/2017	Virginia Hecker	Watertown resident	Email to Michael Clark	traffic	M. Clark sent response
2017-07-05_2	7/5/2017	Kevin MacDonald	Watertown resident	Email to Michael Clark	traffic, bike	M. Clark sent response
2017-07-05_3	7/5/2017	Susan Kananovich	Watertown resident	Email to Michael Clark	traffic	M. Clark sent response
2017-07-06_1	7/6/2017	Sarah Ryan	Watertown resident	Email to Michael Clark	traffic	M. Clark sent response
2017-07-07_1	7/7/2017	David & Alice Martin	Watertown resident	Email to Michael Clark	bike	M. Clark sent response
2017-07-10_2	7/10/2017	Dorothea Hass	WalkBoston	Email to Michael Clark	pedestrians	M. Clark sent response
2017-07-10_3	7/10/2017	Joseph Levendusky	Watertown resident	Email to Michael Clark	bus, traffic, other	M. Clark sent response
2017-07-10_4	7/10/2017	David Wong	Mt. Auburn Club	Email to Michael Clark	business parking	M. Clark sent response
2017-7-10_5	7/10/2017	Aaron Dushku	Watertown Town Councilor At Large	Email to Michael Clark	bus, public transit	M. Clark sent response
2017-7-10_6	7/10/2017	Nancy Kay		Email to Michael Clark	traffic, safety	M. Clark sent response
2017-7-10_7	7/10/2017	Carol Wilson-Braun	Watertown resident	Email to Michael Clark	safety	M. Clark sent response
2017-7-10_8	7/10/2017	Jeff Wilson-Braun	Watertown resident	Email to Michael Clark	traffic, safety	M. Clark sent response
2017-07-24_1	7/24/2017	Robert Lauricella	Board member, Trees for Watertown	Mailed to Michael Clark	transit, design	No response necessary

From: Larry Stabile
Sent: Saturday, June 10, 2017 12:38 PM
To: Clark, Michael (DOT); Laura Castelli
Subject: Arsenal Street Corridor Study Working Group, Meeting 6

I read with interest the presentation of the Arsenal Street Corridor Study Working Group, Meeting 6, and have a couple of comments. I live in Cambridge, and I frequently bicycle out to Watertown Square or beyond, often looping around from the "Boston" side to the Watertown side, continuing down Charles River Road, thence to Greenough Blvd. The rides along these boulevard-like roads are usually very pleasant. The latter part of Greenough, nearer to Harvard, has recently been redone -- a superb job, by the way -- and with the end of the drought, is nicely grown out.

With respect to Charles River Road, as noted in slide 21 of http://www.massdot.state.ma.us/Portals/17/docs/ArsenalStreet/MtngPres_3217.PDF, if I understand "complete streets" correctly, then it's likely a project whose goal is to make modern improvements to a street to accommodate the range of uses from auto to pedestrian to bike. This is laudable, however please be wary of introducing changes which would siphon off more traffic from Arsenal Street. Note that Charles River Road has a nice bike lane, so changes there are not needed. Traffic there is normally very light, which makes for a nice atmosphere, although it's not far from Watertown Square and the Arsenal Mall.

The bike paths and boulevards along the Charles are among the gems of the greater Boston area. When riding along the river, one can feel a bit of open countryside, when in fact the city is very close by. Corridor projects and related work should always remember to account for this ambience.

Thanks for all the public involvement and I hope the project is a success.

Larry Stabile
Cambridge

-----Original Message-----
From: Bill
Sent: Friday, June 23, 2017 8:02 PM
To: Clark, Michael (DOT)
Subject: Watertown bike lanes

Let's see if I have this right? Benefit of being on the river allows for bikes and walkers aka people/citizens ...PLUS a community path among old rail tracks . 5 main thoroughfares out of and into Watetown Square! All 5 need room for bike lanes?? and most thoroughfares reduced to singe lanes in and out of square??? I'll never be confused with what a traffic engineer has to say. But we don't need 8+lanes for bikes.. A biker has pick of Charles River Road, N Beacon, Main st, Arsenal, Mt Auburn and finally Belmont street-with no worry about gridlock. How many miles north to south is it from Belmont to Charles River Road plus the river and community path! Bikers pick one or two, not all 6 or 8! My goodness we've lost our way. Cars get 5, one lane ways out of town from the square while bikes get 8+ routes does that seem fair. How many bikes go in and out of town daily. How many cars go in and out of town daily. A survey must of been done right???? I would like some answers to the questions provided. Thank you for your time in this matter.

WM

-----Original Message-----
From: Kokoros, Theodore
Sent: Sunday, June 25, 2017 3:01 PM
To: Clark, Michael (DOT)
Subject: Arsenal St Corridor Study

Hello,

I am a Watertown resident who does not own a car. I usually ride my bike or take the bus to get around. I wanted to comment on the Arsenal St Corridor study I wholeheartedly support Alternative 3 in chapter 4 of the final draft report. Having complete streets on Irving and Beachwood would make it easier and more obvious for less experienced cyclists to go form the Charles River bike path the Watertown greenway. I also think alternative 14 to improve and add transit shelters would be very helpful. Boston area weather can be terrible and having more shelters while waiting for the bus would make taking the bus a lot more easier. I have older family who live in the area and I know for them having a place to safety sit while waiting for the bus would be a great benefit.

Thanks for the hard work that was put into the study and asking for residents feedback.

Teddy Kokoros
Sent from my iPhone

From: mciro
Sent: Thursday, June 29, 2017 11:31 AM
To: Clark, Michael (DOT)
Cc: nbeacon.neighbors@gmail.com; lfeltner@watertown-ma.gov; msideris@watertown-ma.gov; apalomba@watertown-ma.gov; adushku@watertown-ma.gov
Subject: Comment to the Arsenal St Corridor Study

Dear Mr. Clark,

I am very worried about the consequences of the rerouting of Charles River Road. I feel this is all about traffic flow without considering the impacts to neighborhoods, pedestrians or bicyclists.

I noticed that there was a bullet point to do further research on cut-through impacts that would occur from this change. This should be done before you submit a drawing or suggestion, not afterwards. Put viable, vetted ideas on the table, not something that has not been thought through completely.

- Because of the intense development along the Arsenal Corridor, Charles River Road will have to bear the brunt of some of the traffic with N. Beacon Street. No one will want to go along Arsenal St with its zillion traffic lights and constant stopping for turns unless they have to. **The point of any change should be to slow down traffic and discourage commuter speeding.**

- I see moving around will become harder for ALL (residents and visitors) both west and east of Perkins.

• With this plan to reroute CRR, I believe that all our streets will suffer ***a lot*** of cut-through traffic. How do I know this? Because I know I will want to avoid N. Beacon St (I do now) and go west on CRR. I will end up cutting through myself, and if I do this, you can be sure frustrated commuters trying to get out of the tie-ups on N. Beacon will too. This will not make the great amenity of the CRR riverfront safer to access and will make residents' lives worse.

Whenever traffic backs up from the CRR/N. Beacon intersection now, I see a lot more cars barrel down Bay St (where I live) trying to get away. U-turns at the end of our streets are a specialty of this crowd too. Then what do we do—make our streets one way? Make thruways of Beech and Irving Sts? Planning should require thinking about consequences.

• The tiny bit of extra green space near the dock is not worth making a big mess of this road. The cars are not going away whatever we do.

AGAIN, this CRR plan routs traffic east from Watertown Sq, while making it difficult to go west. It turns this simple grid of streets into a maze full of frustrated drivers trying to get away from the resulting gridlock on North Beacon St. and makes it more difficult for residents to get around by car. Irving and Beechwood Sts, as well as the streets east of Perkins will see much greater volume of cut-through traffic.

If the issue is traffic volume and speed, why you don't just put raised crosswalks at most or every intersection on CRR? This would slow traffic AND would discourage use of this road for commuting, but still allow it for those willing to go slower AND make it safer for pedestrians and bicyclists AND prevent cut-through issues AND keep neighborhood flow intact AND be cheaper. We need traffic calming, not road redesign. Is this just too easy?

Thank you,

Marcia Ciro
Watertown, MA

From: Mary McGreal
Sent: Tuesday, July 04, 2017 8:10 AM
To: Clark, Michael (DOT)
Subject: Arsenal Street Corridor Transportation Study

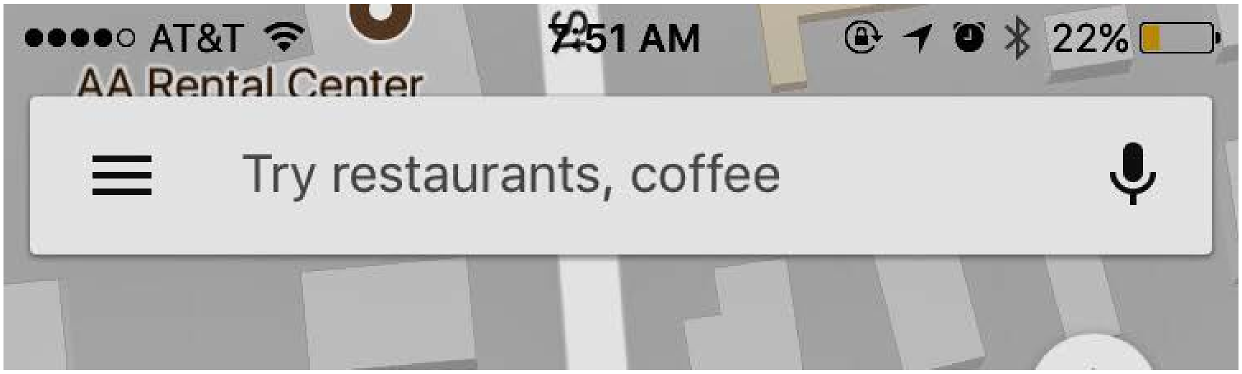
Hi Michael,

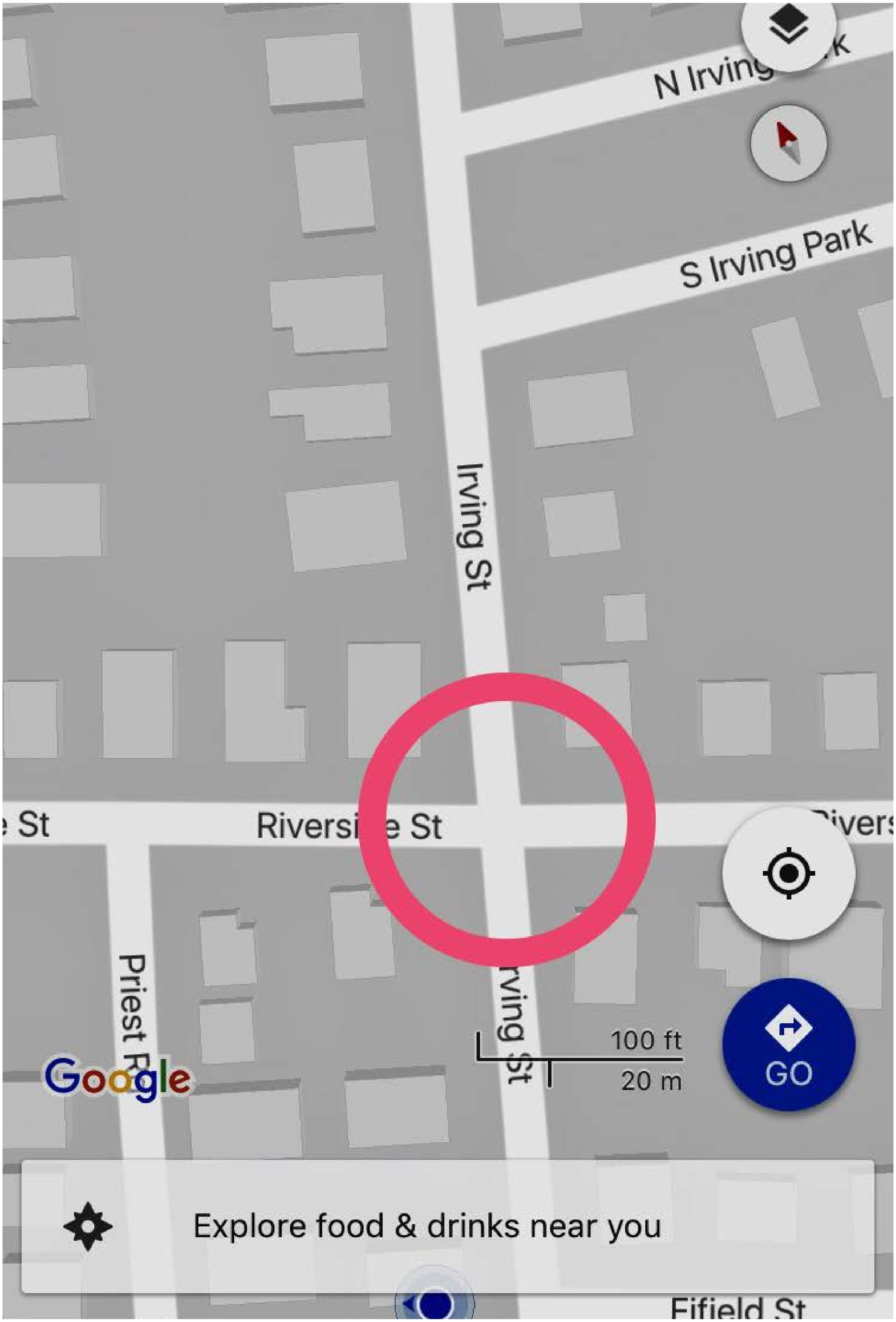
I'm writing with comments in regards to the Arsenal Street Corridor Transportation Study, hopefully you are the correct contact or you could direct me towards the proper channel. I'd like to express my concern about a particular intersection on Irving Street (and Riverside) and the potential for accidents should there be increased vehicular traffic.In the past year, there have been two accidents that I know of at the intersection in the screenshot below.

Two accidents may be statistically insignificant, but it's emotionally significant to see and hear a car flip over in front of your house. The other one occurred when someone blew through the stop sign. It needs to be a four way stop before the state or town starts sending overflow traffic through. Obviously, the driver makes his or her own choices, but I don't believe it prudent to tempt fate, especially so close to a school that serves many students who are deaf and blind (as well as having a number of independent adult staff members who are blind who use these roads and sidewalks to get to work).

I would like to hope that any planning and rearranging of traffic flow considers this, and takes the appropriate measures to ensure the safety of Watertown residents. **I say "hope" since my expectations are set very, very low--I was almost hit from the side by someone running a red light last year on Arsenal Street while I was on Irving, since the light was not visible in the direction they were going (I had the green light).** This was remedied and they added another light (I probably was not the only one who reported this), but oversights and shortcuts like these will eventually cause someone his or her life.

Thank you,
Mary

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-----Original Message-----
From: Virginia Hecker
Sent: Wednesday, July 05, 2017 10:02 AM
To: Clark, Michael (DOT)
Subject: Arsenal St. Corridor Study

Dear Mr. Clark,
I am writing to express some concerns about the re-routing of traffic on Charles River Road.
If I understand correctly, there will no longer be access to Watertown Square via that route, only via Mt. Auburn and Arsenal.
Both of those routes are chronically congested already at certain times of the day, and Charles River Road is such a great alternative for residents to drive to the Square, particularly for those living in my particular neighborhood off of Irving Street, which will become more and more congested as new apartments are occupied.
I understand that traffic patterns will change as part of the plan, but I do not see how congestion will be relieved if this alternate route is eliminated.
Perhaps I need a further and clearer explanation, but at the moment I find this new option distressing.
Thank you.
Virginia Hecker
Watertown

Sent from my iPhone

From: Kevin MacDonald
Sent: Wednesday, July 05, 2017 12:27 PM
To: Clark, Michael (DOT)
Subject: Arsenal Corridor Concerns

I live on Beechwood Avenue and the possibility of closing down Charles River Rd into the square and funneling traffic onto the already overloaded Irving St will destroy the entire neighborhood. Also, enough with the bike nonsense. Making Beechwood and Pequossette/Paul St's 1 way would be a disaster for the residents here. Have the path go from school st, thru Athena Health, connecting then to the ALREADY BUILT bike path along the Charles River that goes to the square.

Respectfully,

Kevin MacDonald
Watertown, MA

From: Kananovich, Susan
Sent: Wednesday, July 05, 2017 4:14 PM
To: Clark, Michael (DOT)
Subject: Arsenal Street Corridor Study

As a resident of Horizon East and member of the Mount Auburn Tennis Club, both on Coolidge Avenue, I am in total disagreement with the proposal to close Coolidge Avenue at the corners of Arsenal and Arlington Streets. The morning traffic with UPS trucks and the lineup of trucks by Aggregate Industries will only intensify.

I am a long time Watertown resident and am dismayed by the enormous development in what once was a small residential town.

Susan Kananovich

Susan Kananovich, MPH
Watertown, MA

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From: Sarah and John Ryan
Sent: Thursday, July 06, 2017 9:23 PM
To: Clark, Michael (DOT)
Subject: Fwd: A few reminders

Dear Mr. Clark,

Reviewing the MassDOT Arsenal St Corridor study, I am very encouraged about all aspects of this proposal which focus on public transportation:

Transit Service Improvements to Existing Routes - my first choice
Transit Shelters
Transit Signal Priority - also good ideas

N, Beacon Express bus. maybe a good idea, but we MA should focus on improving the bus lines that we already have first.

I am concerned about the cross connectivity between the Greenway and the Charles River. There are residential neighborhoods between Charles River Road and the entire length of Arsenal St. These areas are already impacted by increased traffic with new construction developments, so I would be cautious about any changes to this area that would further inconvenience neighbors in this community. One way streets are not a great solution, though multiple traffic calming options and increased pedestrian and bikeway access would certainly be welcome.

thank you,
Sarah Ryan
Paul St.
Watertown

From: Dave Martin
Sent: Friday, July 07, 2017 2:56 PM
To: Clark, Michael (DOT)
Subject: Mass DOT North Beacon / Arsenal Streets Proposal

Dear Sir,

I live on North Beacon St (1 1/2 blocks east of Perkins) and am heavily impacted by any plans made that affect North Beacon and the adjacent side streets. I cannot fathom where this manufactured concern of bicycle access to the Charles River being a problem originated from. Please enlighten me.

I am a weekend biker and find no difficulties with North Beacon St as it exists as well as the surrounding side streets. I loathe these asphalt bike speedways that have been set up. I find them offensive to the eye and invasive to our neighborhood and community. There are painted bike lanes that already exist on North Beacon St and they suffice quite well. Please let them be.

The idea of making Irving, Beechwood, and Louise / Paul St one way just for the convenience of a hand full of bikers is outrageous. It will greatly inconvenience the residents for a no hard proven reasons.

We live here because we enjoy the peace and tranquility of our area as it exists. The idea of bike highways being a necessity is a false one. Creating an artificial demand results in poorly thought, out artificial solutions that create real problems instead of solving the imaginary ones.

There are many of us that feel this way. The I Cubed plan porposed by Athena is wraught with major problems. We will be vocal about that plan as well so I Cubed as proposed is not a done deal.

Please leave our street markings alone. Please do not destroy our neighborhoods....

Thank You,

David Martin
Alice Martin
Watertown

From: Gordon Brown
Sent: Saturday, July 08, 2017 3:14 PM
To: Clark, Michael (DOT)
Subject: Arsemal Street +++

I see more buildings going up for both residential and retail use along with parking garages to accommodate the extra traffic that will be generated and I see Arsenal Street already being reduced in lanes. You want to generate more bicycle usage I believe, but many of we seniors cannot use them.

So more traffic and reduced lanes is a solution? I don't think so. We have way too many narrow streets in town as it is.

And I would hope that in this computerized age, traffic lights could be much better timed to allow a freer flow of traffic. It is really dumb to have to stop at every light, on Arsenal Street, especially at 11 or 11:30 at night when malls are closed, and traffic is often times non-existent.

Years ago, when visiting relatives in Conn. there was a 10 mile stretch of highway, Routes 5 and 15, I believe, from New Britain similar to our Route 1 with

lots of cross streets and businesses leading to the Conn. parkways. Once you entered
and left a traffic light, anywhere on this stretch of highway, and maintained speed at 45 MPH,
you did not have to stop for light at all. And this was long before computerized controls.

Other long stretches in Watertown such as Mnt. Auburn, Maine and Pleasant Streets. could
also be controlled in this way. AND YOU DON'T NEED TO SPEND MILLIONS OF DOLLARS ON
A STUDY. Just use some common sense and someone who knows how to program.

Just my opinions.

Gordon Brown
Quirk St. R

From: Jonathan Bockian
Sent: Sunday, July 09, 2017 11:47 AM
To: Clark, Michael (DOT)
Subject: Comment on Arsenal Street Corridor Study Draft Final Report

Thank you to the DOT and our state legislative delegation for requesting this Study and inviting public comment, and thanks to VHB for their work. The good news is that attention and resources are being focused on a serious problem that intensive development is making worse, namely transportation in Watertown generally and the Arsenal St. corridor in particular. The Study offers some good ideas but the proposed improvements are not enough for the scale of the problem or not sufficiently thought out.

The Study intentionally put on a pair of seriously limiting blinders: the limitation of the study area and the decision to leave out significant MBTA improvements. Both of these self-limitations are understandable: a boundary has to be drawn somewhere despite how interrelated each part of our area is with every other part, and the MBTA's Watertown problems reflect the systemic problems of the entire MBTA. Still, meaningful change to transportation on the Arsenal corridor cannot be achieved without more attention to the relationship with other adjacent transportation corridors and neighborhood streets or without dramatic improvement to the MBTA's Watertown services. A route change to the 70/70A bus line will help, and every bit of help is welcome, but it is nowhere near enough. These subjects must be addressed immediately if East Watertown's success isn't to be strangled in its cradle by traffic woes.

Another omission from the Study is that while DOT properly needs to know what government can do, solutions to public transportation problems worsened by intensive private development need substantial help from those developers to be effective. More of the Study could have focused on what money and in-kind contributions these sources can make in addition to what the Town already requires of them. If there are legal or policy obstacles to how these private resources could contribute to the MBTA to improve local services, these obstacles should have been identified and solutions proposed. The real estate and corporate developers would benefit from collective solutions at least as much as the general public would.

The question raised by these criticisms is who will now take up the burden of filling in the gaps in this DOT Study?

Of the proposals that the Study offers, one that particularly needs more study and public input is Alternative 7, Watertown Square Gateway Improvements. This alternative proposes a realignment of Charles River Road (CRR) where it meets Watertown Square. This proposal was made without sufficient existing traffic conditions data. It is regrettable that although the Study's geographic local area purported to include North Beacon down to Charles River Road, the Study did not report any data about current conditions or future impacts of this proposal on North Beacon Street, Charles River Road and the cross streets. We need a thorough, credible traffic analysis of the entire area from North Beacon to CRR, from Little Greenough to Watertown Square, including the cross streets, before we can begin to understand what price the neighborhoods will pay, and what benefits the neighborhoods may get, for a possible improvement to the flow of traffic through Watertown Square. Despite calling itself a "study," the Report has not seriously studied this option before proposing it.

Thank you for considering these comments.

Jonathan Bockian
Watertown

From: Al Gordon
Sent: Monday, July 10, 2017 10:02 AM
To: Clark, Michael (DOT)
Cc: Betty Gordon
Subject: Comment: Arsenal Street Corridor Study

We are residents of the Horizon East Condominium at 125 Coolidge Avenue in Watertown, and we are writing to strongly object to the proposals in your latest report that would close off Coolidge Avenue at Arsenal.

In particular, we oppose the “Alternative 6: Soldiers Field Road Gateway Improvement” plans – and further protect the failure to conduct proper outreach to residents on the avenue, we are clearly relevant stakeholders. The public hearings were not an adequate substitute for direct contact – especially since the scope of the study project was generally regarded to be traffic patterns on Arsenal Street, but not other streets.

This proposal (beginning at page 161 of the report) includes two options -- Arlington Street Relocation (see figure 5-6) and Arsenal Street Relocation (5-7) – both of which would cut off access to Arsenal Street from Coolidge Avenue. Residents of our condominium (and three adjacent ones) would be able to drive only as far as the back end of the Dunkin Donuts property and then would be blocked. A major consequence would be to divert gravel and UPS trucks away from the Arsenal project – and back toward us.

Instead, the “Arlington” option calls for building a new road that would start on Coolidge Ave. across the street from the Mt. Auburn Club (which is to say a few hundred feet from our driveway) and cut around the UPS lot and pop out onto Arlington Street about where the UPS dropoff location is. We then would reach Arsenal Street at the current intersection with Arlington. Essentially moving the traffic into the same intersection that you are supposedly trying to "fix."

The "Arsenal" option appears to run from just past the Mt. Auburn Club's parking lot (the one furthest from Horizon East) and pops out on Arsenal Street between the Dunkin and Greenough Boulevard, which would pretty much be no-man's land for merging into Arsenal Street. We see a high level of danger in the resulting traffic flow.

Under either plan, first responders would be unable to access our street directly from Arsenal. Particular the police, which surely will have move units positioned in the vicinity of the Arsenal project,

Additionally the plans appear to be expensive to execute – we think the cost estimates are woefully low – and would require various environmental permits that, if granted, might adversely affect groundwater flow. Also, there is the potential to further complicate the decontamination issues at the so-called "GSA Site."

While we look forward to the new amenities that "Arsenal Yards" might bring to Watertown's East End, we find it troublesome that our street would be cut off from direct access to the project

We ask that you drop the Alternative 6 proposals.

Sincerely,

Betty and Alan Gordon

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From: Dorothea Hass
Sent: Monday, July 10, 2017 1:25 PM
To: Clark, Michael (DOT)
Cc: Lisa Feltner; Schreiber, Gideon; Watertown.BikePed@gmail.com; Charlie Denison; Wendy Landman
Subject: Arsenal Street Corridor Comment Letter

Attached please see WalkBoston's comments on the Draft Report of the Arsenal Street Corridor. As we indicate in our letter, there is very mention of the Corridor's impact, positive or negative on pedestrians.

WalkBoston requests that the Final Report address the vision for walking along and across the Corridor as well as provide specifics necessary to implement the vision.

--
Dorothea Hass
WalkBoston

Click here to join or renew your membership: Donate Now!

walkBoston™

July 10, 2017

Michael Clark
MassDOT Office of Transportation Planning
10 Park Plaza, Suite 4150
Boston, MA 02116

RE: Arsenal Street Corridor Study

Dear Mr. Clark:

WalkBoston has reviewed the Draft Report on the Arsenal Street Corridor. We found the report very thorough in addressing the vehicle impacts – auto, bus and bicycle - of the various alternatives. However, we were surprised that there was hardly any mention of the impacts upon walkers.

WalkBoston would like to know specifically how the alternatives will increase pedestrian safety, facilitate comfortable movement along and across the corridor. For example, will traffic signals be concurrent? Will the WALK phase be automatic? Approximately, how long will pedestrians need to wait to receive a WALK to safely cross the street?

The omission of the alternatives' impacts upon pedestrians is particularly surprising given that a bus ridership is already high on the corridor and projected to increase. The vast majority of riders walk to bus stops. The most specific pedestrian benefit was cited in Alternative 12: Watertown Square Bus Alternative which indicated that closer proximity of ending/starting points for the buses would increase pedestrian safety because it would "reduce the number of pedestrians running to catch buses."

WalkBoston as a promoter of alternative transportation modes is supportive of many of the recommendations such as: transit signal overrides for buses, bus shelters, and safer bicycle accommodations as well as improved bicycle connections between Arsenal Street and the Charles River. However, again, the Draft Report does not address pedestrian accommodations or routes.

WalkBoston looks forward to a Final Report that specifically describes how the pedestrian experience along the Corridor will be safer, pleasanter and more convenient.

Sincerely,

Dorothea Hass
Sr. Project Manager

cc: Watertown Bicycle and Pedestrian Committee
Lisa Feltner, Councilor
G. Schreiber, Town Planner

From: Joseph Levendusky
Sent: Monday, July 10, 2017 2:03 PM
To: Clark, Michael (DOT)
Cc: towncouncil@watertown-ma.gov; Steve Magoon; Michael Driscoll
Subject: Arsenal Corridor Draft Report

Dear Mr. Clark—

I am writing in response to the Arsenal Corridor Study Draft Report.

Most of the ideas suggested in the report are of high merit and movement toward implementation should begin at the soonest possible moment. Items 1 and 3 have obvious utility. So do items 11, 14 and 17. We should begin tomorrow on these.

Item 15 is not only worthy, but is critical. If the timeline to implementation could be shortened, the impact on those who live, work and do business in the vicinity of the Arsenal Corridor will be extremely positive.

Item 7, the Watertown Gateway improvements, deserves further study and public input. While the goal is sound—easing a traffic choke point that impacts the number 70 bus—the idea of re-routing the west end of Charles River Road may be controversial. And I am not sure that it is the best solution to the problem. It might also have unintended consequences, as Charles River Road is now the safest way for bicycles to reach the Watertown Square intersection.

Item 10 seems as if it could use further thought and planning. It seems apparent that an expedited or express bus route along North Beacon Street could take considerable pressure off the number 70 line. But as proposed, I do not believe that it is a bold enough stroke. First of all, it should be a full time route. Secondly, the route, as proposed, does not accomplish enough.

I would propose that North Beacon Street line originate in Waltham using River and Pleasant Streets as its route to Watertown Square. This would provide additional service to the West End of Watertown, which is currently underserved. It would also provide service to the Pleasant Street Corridor of Watertown which is experiencing a boom in residential development and currently lacks transit service. The route, by providing a service alternative in the West End, could take considerable passenger load off the number 70 line.

Pleasant/North Beacon service would provide a connection to the 70 and 71 buses (and presumably also the Watertown TMA shuttle) at Watertown Square and would then proceed down North Beacon to a destination as yet undetermined, perhaps the future West Street Station. I would like to point out that this proposal would provide additional service and capacity without adding additional bus traffic to the Arsenal Corridor.

I would also suggest that these measures represent a great start toward ameliorating the problems we face today, and will face in the near term future. But I do believe that ongoing study and further measures will be necessary to meet challenges posed in the longer term.

Thank you for your time and attention to these comments.

And also a big thank you to all involved in Arsenal Corridor Study. I appreciate the attention that has been paid to the transportation problems we face in Watertown.

Joe Levendusky

From: Donald Wong
Sent: Monday, July 10, 2017 3:14 PM
To: Clark, Michael (DOT)
Cc: 'Bill Crowley'
Subject: Arsenal Street Corridor Plan

Dear Mr. Clark,

I am emailing on behalf of William Crowley, owner of the Mount Auburn Club in Watertown, MA and we are writing you to firmly oppose the proposed relocation of Coolidge Avenue in the "Alternative 6: Soldiers Field Road Gateway Improvement" of the Arsenal Street Corridor Study prepared by VHB and released in June 2017.

The relocation of Coolidge Avenue, depicted in both figures 4-5 (page 132) and 5-7 (page 163) of the study, is shown to run all the way through the Mount Auburn Club parking lot and would cause irreparable damage to Mount Auburn Club by causing our business to lose at least 60-80 valuable parking spaces which are used daily by our community of over 3000 members and guests. By eliminating such a significant percentage of our available parking spaces, Mount Auburn Club would suffer significant loss of business and damage to our reputation built over 43 years as MAC members would terminate their memberships due to the very real inconvenience and lack of service that the loss of parking spaces would cause to our paying members and guests.

In conclusion we are not in favor of the proposed relocation of Coolidge Avenue, however we are in favor of the overall plan to help improve traffic flow in the Arsenal Street corridor.

Thank you for your efforts and work on the Arsenal Street Corridor Project.

Donald Wong
Executive Manager
Mount Auburn Club
57 Coolidge Ave.
Watertown, MA 02472

From: Aaron Dushku
Sent: Monday, July 10, 2017 4:55 PM
To: Clark, Michael (DOT)
Subject: Arsenal Corridor Study final comments

Dear Mr. Clark,

Thanks for the opportunity to comment on the Arsenal Corridor Study report.

First, a minor matter, there were several typos in the maps or text under the discussion of the proposed 'trunk' route of the route 70 bus where it mistakenly labeled it as the 'truck' route and this is misleading.

Second and more substantive, I bring to question the matter of the proposed express bus along N. Beacon Street. While I applaud the project team for taking this idea to heart and producing some recommendations for a pilot program, the imaginative forces behind the idea seemed lacking in the face of a cruel 'reality'.

With 33,000 students and almost 14,000 employees, BU is a magnet destination for Watertown residents while the greater Longwood Medical area boasts an impressive list of hospitals, research and educational institutions. Beth Israel Deaconess Medical Center, Boston Children's Hospital, Brigham and Women's Hospital, Dana-Farber Cancer Institute, Joslin Diabetes Center, Boston Latin School, Emmanuel College, Harvard Medical School, Harvard School of Dental Medicine, Harvard Chan School of Public Health, Mass College of Art and Design, Mass College of Pharmacy and Health Sciences, Northeastern University, Simmons College, Wentworth Institute of Technology and Wheelock College are just a handful of these places. They represents thousands of potential employment opportunities and current destinations for discontent Watertown SOV commuters. Not to mention, the opportunity for Watertown residents to connect directly to the Green line on Commonwealth

Avenue could have opened up a whole new entryway to the Back Bay, downtown Boston and even BC in the outbound direction. Such an vision seemed all-to-quickly dismissed and a game-changing scenario of a real BRT line never had a chance.

I can't help but wonder why alternative routes to the Green Line from North Beacon street such as Gordon Street-to-Warren Street and back by way of Sparhawk and Parsons Streets were discarded or not considered. Such routes could have created more right-turn opportunities and avoided the gridlock of Brighton Ave's narrow passing and major intersections. The speed gained through implementing a real BRT system in Watertown could make up for delays in the denser streets of Allston/Brighton while taking pressure off or even replacing the 57 (or the eastern half of it). With stretches of single ownership ripe for eminent domain takings along the narrowest sections of North Beacon Street and public lands leading up to and through the Soldiers Field Road intersections, a truly transformative system isn't hard to envision. Even a route that went up Birmingham Parkway and along Lincoln Street or parallel to it on the Turnpike ROW could have avoided North Beacon Street in Brighton altogether and yielded conflict-free access to the Everett Street pedestrian overpass and be factored into the design of the future West Station as a turnaround.

Lastly, the assumption that the fledgling Watertown TMA could be the one to implement this pilot route felt like a very convenient way to deflect any potential responsibility from the state and onto the municipal and the private sector. MassDOT leadership could have instead rallied us behind an inspirational goal and really interconnect our two cities in a way that everyone could support. The Watertown TMA is in its infancy and it feels unfair and unrealistic to drop this expectation on this institution if you really supported it as a viable idea.

On to the positive. I am grateful for the dedicated work of VHB, Regina Villa, the MBTA, MassDOT and the working group throughout this process. Many Watertownians are very excited to see the proposed changes to the 70/70A bus routes which has been largely un-usable to many residents due to its undependable nature, crowding and unbearable wait times. In reading the report, one can really see the effects of a lot of work and data analysis in the justifications for this and that is greatly appreciated. Optimistically, we look forward to the potential addition of 4 new buses and the headway regularity that the proposed reconfiguration could someday bring and hopefully this will be in time to help us weather the storm of the growing number of new residents and businesses on Arsenal Street. It is encouraging that the MBTA is ramping up for some service delivery planning and this report comes at a perfect time to play a part in that process and has built a great case for us to argue for service improvements.

The enhancements to the cyclist experience on Arsenal Street are helpful as is the redesign plan for Watertown Square which I think will create a safer passage for cyclists and pedestrians while reducing the wait-time for buses traveling through on the 70/70A. I look forward to further discussion of the Watertown Square planning so that the relocated bus stop from Main Street can be appropriately sited. This will also lead to greater efficiency for transit riders who want to transfer to the services at Watertown Yard.

Thank you to our legislators who brought state investments to this effort and for their time spent to make that happen as well as throughout the process.

Sincerely,
Aaron Dushku
Watertown Town Councilor At Large

From: Nancy Kay
Sent: Monday, July 10, 2017 8:01 PM
To: Clark, Michael (DOT)
Subject: Arsenal Street Corridor Study

Dear Mr. Clark –

As a resident of Watertown for over 25 years and as a homeowner in Irving Street/Park neighborhood, thank you for the excellent summary you provided regarding the Arsenal Street Corridor.

I was not able to attend the meeting regarding this project directly, but have been following all of the recent articles and have read the entirety of your final draft. Many of my neighbors did attend the recent meeting and have shared the information.

We live the traffic issues in Watertown every day. I am an independent financial contractor that works with small businesses and using public transportation to my clients is difficult at best. I love my town and my neighborhood. We are all deeply concerned about the overall issues facing Watertown, but in particular the proposed rerouting of Charles River Road traffic through Riverside Street as well as Irving Street.

Irving Street currently (and at many times in the day) becomes gridlocked between Arsenal and North Beacon. That stretch is not long enough to accommodate many cars and sometimes it takes several light cycles to make it through, whether cars are going straight or turning, they are blocking the intersections. And this is without the new development on Arsenal and Irving adding additional traffic.

Our vibrant neighborhood is filled with families. Although my own child is 23 and has moved away, there is a new resurgence in the neighborhood and we currently have 4 new babies in purchased homes in a two block radius. There are many toddlers and young children who play in the park and ride their bikes on these streets. In addition, we have a growing number of dogs that bring together all types of people, single, married, families, retirees from the many different streets. We've had block parties and many of us have lived here for over 20 years. And these factors don't even take into account the impact this could have on Perkins School for the Blind, where students and staff routinely walk these streets.

I'm concerned that pushing traffic through our neighborhood will cause us to lose many of these wonderful attributes which might not seem like much in the scope of the many changes planned, but it could be debilitating to us. Cars that cut through now often speed down the street, sometimes not even slowing down for the stop sign. We acknowledge that we live near two very busy streets and a commercial part of Watertown, but is it necessary for us to possibly forfeit our neighborhood that we love to accommodate traffic issues that were not considered when all of these developments were approved.

I respectfully ask that our neighborhood's concerns are taken into account as we all progress to the many changes that are coming our way. The work that MassDOT has done on our Watertown's behalf if truly amazing. And I believe will make a difference in the everyday quality of our town.

Thank you for your time and attention to this matter.

Best regards,

Nancy Kay Demick

Watertown, MA

From: Carol Wilson-Braun
Sent: Monday, July 10, 2017 10:05 PM
To: Clark, Michael (DOT)
Subject:

Hi Mr Clark, I am a resident and home owner on Irving St. and I attended the meeting on the Arsenal St corridor at the Watertown Public Library last week. I wrote some comments then but wanted to elaborate a little more now. I am on the Watertown Commission on Disabilities and have heard reports of Perkins students feeling fearful of the intersection of Riverside and Irving streets. There was a bad accident there in late May. If the westbound traffic on Charles River Rd is funnelled up Irving St, this will be much worse. I think it is a very bad idea. There are also families with young children and dog walkers around Riverside and Irving and Irving Park and a school bus stop. Irving St has been a relatively quiet neighborhood. As a driver, the traffic on Irving going north has gotten much worse, especially with the closure of Louise St and the restriction on Beechwood. But even before that construction, it has become very difficult to get out of the Irving Park neighborhood, across N. Beacon. The traffic lights have been reconfigured with the construction on Arsenal, and it has been awful for the people in the Irving Park neighborhood to leave, particularly at rush hours. This morning, it took two full light cycles and then a quick scoot through a yellow light for me to continue north toward Arsenal. I generally like the changes proposed to Watertown Square, specifically the lane markings and the separate green lights for Galen and Mt. Auburn traffic to cross the intersection. I am hoping that those changes will improve the square enough that no changes need to be made to Charles River Rd. Can we see how those first changes work first? I don't want to lose our quiet neighborhood and have many more speeding cars travelling through- and make traffic so much more worse than it already is. Thank you for your attention, Sincerely, Carol Wilson-Braun

From: Jeff Wilson-Braun
Sent: Monday, July 10, 2017 11:16 PM
To: Clark, Michael (DOT)
Subject: Irving Street as a thruway to Watertown Square

To whom it may concern: Not in favor from a neighborhood perspective. Irving Street and the surrounding blocks between N. Beacon St and Charles River Road are family oriented and relatively quiet. Sending additional traffic will lower the quality of living and possibly the value of the housing stock. With this proposed change, connecting Watertown Square bound traffic from Charles River Road north on Irving St to get to the Square, will come vehicles seeking alternative thruways when Irving St becomes clogged by its intersection at the traffic light with N. Beacon St. This means additional traffic going either way on Riverside either to gain access to N Beacon via Royal St or via Ladd St and Alfred Road. Or zipping up Irving Park North and South which surround a small park for children, dog walkers, and those who enjoy a small bit of bucolic scenery in a city where green space is already at risk. Many cars already move with surprising speed and possibly above speed limits on Irving the short distance from Riverside to N Beacon. Additional cars with folk seeking to go to work or to get to school will likely increase this tendency. The intersections at N Beacon and Irving and also Irving and Riverside have a history of significant vehicle accidents. Rush hour traffic would seem likely to increase accidents. Perkins School staff and residents use these streets for pedestrian training for low vision/blind and increased traffic would seem likely to put them at greater risk. Respectfully. Jeff Wilson-Braun

ARSENAL STREET

CORRIDOR STUDY

Comment Form – June 22, 2016 Public Meeting

1. Please select up to 3 alternatives that you think should be prioritized. *Check the box next to the alternative(s) you select.*

- ☐ (1) Bicycle Lanes east of School Street
- ☐ (3) Cross Connectivity between the Greenway and Charles River
- ☐ (6) Soldier's Field Road Gateway Improvements
- ☐ (7) Watertown Square Gateway Improvements
- ☒ (10) North Beacon Street Express Bus
- ☒ (11) Transit Signal Priority
- ☐ (14) Transit Shelters
- ☒ (15) Transit Service Improvements to Existing Routes
- ☐ (17) Adaptive Signal Control

2. Why do you think these alternatives should be prioritized?

1. THE NEW DEVELOPMENT WILL CONTINUE TO ADD VEHICLES. ONLY TRANSIT IMPROVEMENTS WILL GET PEOPLE OUT OF CARS.

Continued on reverse →

3. Would you like to share any other comments with MassDOT regarding the Arsenal Street Corridor Study Draft Final Report?

THE DOT STUDY DOES NOT ADDRESS THE URBAN DESIGN ASPECT OF ARSENAL STREET. ARSENAL STREET SHOULD BE A "BOULEVARD" NOT JUST A ROAD TO MOVE TRAFFIC.

I KNOW THIS IS TOO LATE BUT I FIGURED I WOULD SEND IT ANYWAY

NAME ROBERT LAURICELLA TITLE BOARD MEMBER

ORGANIZATION TREES FOR WATERTOWN

MAILING ADDRESS ___

EMAIL ADDRESS ____

Please return this sheet with your comments to a staff member at the meeting, or mail to the following address by Wednesday, July 5, 2017:
MassDOT, Attn: Michael Clark, Ten Park Plaza, Suite 4160, Boston, MA 02116.

Thank you for your comments!